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OPHTHALMOLOGY

EDITED IN ENGLISH AND GERMAN

BY

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OF NEW YORK

AND

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VOL. XXXIV. No. 1.

ARCHIVES OF OPHTHALMOLOGY.

THE OPHTHALMO-KINETOGRAPH, AN APPARATUS TO RECORD OCULAR MOVEMENTS.

By EDWARD B. COBURN, M.D., New York.

(*With five figures on Text-Plate I.*)

IN 1900 my attention was attracted by the description of an apparatus devised by Prof. Raymond Dodge of Wesleyan University for recording ocular movements in certain physiological experiments. Its utility for the study of abnormal ocular movements impressed me fully as much as its usefulness in the domain of experimental physiology, and I constructed several instruments of a similar character, employing the photographic method of Prof. Dodge, but modifying his original apparatus in several particulars and increasing its scope.

Description of Apparatus.

A pair of large, matched, photographic lenses (see Text-plate I., Fig. 5 P,P) are mounted in sleeves (for focussing) on a light proof box. The axes of the lenses are inclined toward each other and are directed toward a certain point in front of the apparatus, a point which is predetermined and depends on the focal lengths of the lenses and the size of the tracings desired. By inclining the axes, it is possible to arrange so that the carriers pass each other without interference. In the interior of the box are stretched steel wires on which move two carriers (C_1, C_2) rolling on specially turned, grooved wheels. The carriers move at right angles to each other, one moving horizontally (C_1) and the other (C_2) moving vertically. The wires and carriers are so arranged that they are equally distant from the lenses, so that

the size of the images and their movements shall be equal. The carriers are actuated by clockwork (M) and move simultaneously and at uniform speed. An attachment is provided by which the clockwork is stopped automatically when the plates have passed the focal points of the lenses. On the anterior surface of the carriers are holders for the ground-glass focussing screen and the sensitive plates.

To provide a brilliant corneal reflection, an acetylene gas lamp or electric light with condenser (represented by L) is employed. Under working conditions, the rays of light from L fall on the corneæ of the eyes (E) and are there reflected, passing through the lenses (P,P), by which they are focussed on the plates borne by the carriers (C_1, C_2).

To prevent the tracings of the corneal reflections of the two eyes from overlapping and interfering, a pair of 10-degree prisms (K), side by side, one with base up and the other with base down, are interposed between the horizontal carrier and its corresponding lens. These prisms serve to separate the records of the two eyes. In the upper part of the text-plate (fig. 4) is a drawing showing their action in detail. The dotted line represents the ray of light from one eye passing through the prism with base up (the ray being refracted upward), while the ray from the other eye is shown by the full line and passes through the prism with base down, the ray being refracted downward. With prisms of equal refractive power the deflections are equal and the size of the images and their movements are equal.

Method of Using the Apparatus.

The patient's head is fixed on a support similar to that provided for and used with the ophthalmometer. The light is thrown on the patient's eyes and the lenses are carefully focussed on ground glass placed in the carriers. When both are properly adjusted, the ground glass is removed and replaced by sensitized plates, and the carriers are moved to the extreme ends of the ways. When all is ready, the patient is directed to make certain prearranged movements with the eyes, and the clockwork is set in motion. The plates move steadily in the focal plane and the bright

ILLUSTRATING DR. EDWARD B. COBURN'S ARTICLE.

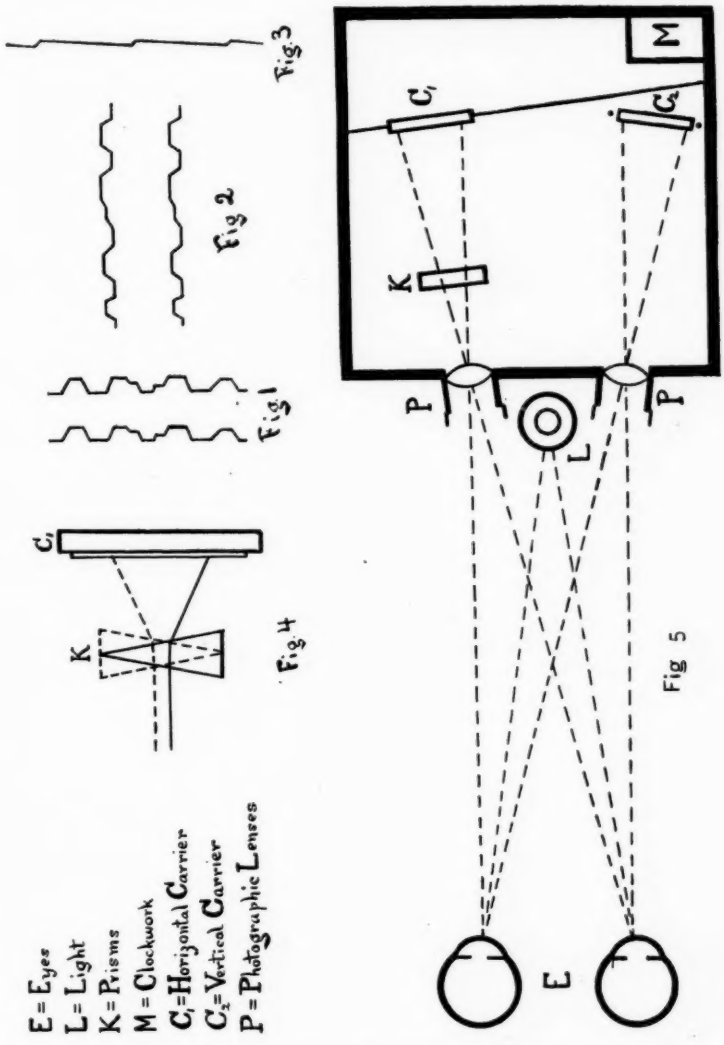

DIAGRAM AND KINETOGRAMS OF OPHTHALMO-PHOTO-KINETOGRAPH.

reflection on the cornea focussed on the plates causes the usual chemical changes. When the plates have passed the focal point of the lenses the carriers stop automatically and the plates are removed and developed according to customary photographic methods. If the exposure has been properly made, a line on each plate for each eye will be observed. Thus, a permanent record of the motion of one eye or the consensual motions of both eyes is made and may be examined at leisure, either directly from the negative, or from positives printed in the usual way. Figure 1 shows a kinetogram taken simultaneously of both eyes moving synchronously in the horizontal plane. The brief period of muscular action is well shown, as compared with the relatively long period of rest at the end of the ocular excursions. It will be noticed that the amplitude of the excursions is equal, and that the periods of rest and motion of one eye equal those of the other eye. Figure 2 shows a kinetogram of both eyes moving vertically.

The optical principles involved are rather complicated, as we have to deal with the image formed through a compound photographic lens of a reflection from a convex mirror rotating around a point posterior to its centre of curvature.

The movements of this reflection are relatively small, but bear a constant relation to the movements of the eyeball.

Uses.

This apparatus is useful for the study of all forms of ocular movements, especially consensual movements, including convergence. On the one hand are the physiological functions, such as the reaction time for various muscular actions, while on the other hand there are the variations from the normal, such as insufficiencies (either congenital, acquired, or operative), nystagmus, the effect of various drugs, as nux vomica, strychnia, alcohol, etc. Rotatory nystagmus may be studied by cocainizing the cornea, and applying to it two small reflecting surfaces, thus giving two points on one eye for record.

Remarks.

My first apparatus was a portable one and films were used instead of plates, but the films were more difficult to adjust and to develop, and it was not easy to give them a uniform motion, and so they were temporarily abandoned. Since my last apparatus was prepared, I have noticed that Dr. Lucien Howe, of Buffalo, N. Y., demonstrated an apparatus for "determining the rapidity of the lateral motions" before the Ophthalmological Section of the British Medical Association at Oxford, July 27, 1904.

Both Professor Dodge and Dr. Howe employ a time-marking device, but this seems to be an unnecessary refinement for the study of abnormal ocular movements.

What we wish to know is the relation of the consensual movements of the eyes, and not the absolute time necessary to perform certain muscular actions. The motion of the plates is regular and uniform, and the relations may be studied directly by ruling the plates or measuring the length of the various lines. For example, Fig. 3 is a kinetogram of a case of horizontal nystagmus, and shows that the active movement of the eyes was to the right, and that the period of rest was from twenty to forty times the period of muscular spasm, the spasms occurring at irregular intervals. The period of muscular spasm was practically constant and was used as the unit of measure.

Owing to the diminutive size of the records, it is sometimes difficult to demonstrate the various lines and properly measure them, but the records may be enlarged by the usual photographic methods, and the processes rendered accordingly more easy.

The size of the records will be the same as the ocular excursions if the distance from the eye to the lens is equal to the distance between the lens and the plate. Any variation from this will cause a change in the size of the records, but the relation may be determined according to the usual formulæ of optics.

If desired, the movements of the eyes may be reproduced on a screen similar to the usual cinematograph reproduction.

It is my belief that this apparatus in some form will supplant the present methods of examining and testing the ocular muscles. It is not the strength or weakness of a muscle that we desire to know, but whether its consensual relations are normal or not, and this fact (in permanent form for recording) may be determined from the use of this apparatus. It is my purpose later to present a further communication, giving in detail a study of abnormal ocular movements as revealed by this instrument.

The name, ophthalmo-photo-kinetograph, suggests itself as the proper appellation of this apparatus, but it is long and rather cumbersome, so ophthalmo-kinetograph has been chosen as a better designation.

THE OPHTHALMIC SUBJECTS TREATED OF IN THE CODE OF ḪAMMURABI.[1]

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AFTER a careful perusal of Professor Harper's transliteration and translation of the *Code of Ḫammurabi*,[2] the writer has gathered together in a brief and connected form some ophthalmic data derived from the work, so that these interesting facts may be accessible to ophthalmologists, without the necessity of searching through the original for each special point.

In the introduction to his work, Professor Harper states that "The Monument on which the Code of Ḫammurabi is engraved was found in December, 1901, and January, 1902, on the acropolis of Susa by an Expedition sent out by the French Government under the Director General, M. de Morgan. It is a block of black diorite, nearly eight feet high, broken into three pieces which were easily re-joined."

"Ḫammurabi, identified by most Assyriologists with the Amraphel of Genesis xiv., 1, was the sixth king of the First Dynasty of Babylon and reigned for fifty-five years, about 2250 B.C. . . . From the Prologue [on the obverse] and Epilogue [on the reverse] we learn that he was a great soldier and a pious, god-fearing king, who destroyed all his enemies to the North and South, and made his people to dwell in peace and security. He codified the existing laws

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[2] *The Code of Ḫammurabi, King of Babylon about 2250 B.C.*, by Robert Francis Harper, Ph.D., Professor of the Semitic Languages and Literatures in the University of Chicago, etc. 8vo, pp. 192, Plates CIII. Chicago: The University of Chicago Press, 1904.

that the strong might not oppress the weak, that they should give justice to the orphan and widow, and for the righting of wrong."

In order to understand the significance and peculiarities of some of the laws herewith given, it must be remembered, as Professor Harper informs us, that "Society in the time of Ḥammurabi consisted legally of the 'AWÎLUM,'" which "included the householders, property owners, the wealthy and upper classes"; the "MUŠKÊNUM," the poor "freeman" who "could hold property and slaves"; and "WARDUM-AMTUM," which "consisted of male and female slaves." "There was also a class of public servants which received subsidies from the government.

In paragraph number 193, we find these words: "If the son of a NER.SE.GA or the son of a devotee identify his own father's house and hate the father who has reared him and the mother who has reared him and go back to his father's house, they shall pluck out his eyes"; a most heroic punishment.

The law of retaliation is shown in paragraph 196: "If a man destroy the eye of another man, they shall destroy his eye." So, too, in many other portions of the code the same law holds good—"limb for limb," "tooth for tooth," "life for life," "son for son," and "slave for slave."

Paragraph 198, "If one destroy the eye of a freeman or break the bone of a freeman, he shall pay one mana of silver," as compared with paragraph 199, "If one destroy the eye of a man's slave or break a bone of a man's slave, he shall pay one-half his price," is very interesting as comparing (truly contrasting) the relative values of the eyes of a freeman and a man's slave.

Paragraphs 215, 216, and 217 read: "If a physician operate on a man for a severe wound [or make a severe wound upon a man] with a bronze lancet, and save the man's life; or if he open an abscess [in the eye] of a man with a bronze lancet and save that man's eye, he shall receive ten shekels of silver [as his fee]; if he be a freeman he shall receive five shekels"; and "If it be a man's slave, the owner of the slave shall give two shekels of silver to the physician."

Paragraph 218, with its drastic penalty of finger excision, reading, "If a physician operate on a man for a severe wound with a bronze lancet and cause the man's death; or open an abscess [in the eye] of a man with a bronze lancet and destroy the man's eye, they shall cut off his fingers," might well deter many a so-called ophthalmic surgeon of to-day from mischievous abuse, and help to keep the profession free from carelessness, incompetency, and quackery, and their consequent disasters: here again is an eye held in the same degree of valuation as that of a life.

Paragraph 220 tells us in regard to slaves that "If he open an abscess [in his eye] with a bronze lancet, and destroy his eye, he shall pay silver to the extent of one-half of his price"; and paragraph 247 states that "If a man hire an ox and destroy its eye, he shall pay silver to the owner of the ox to the extent of one-half its value." Thus showing that the eye value of an ox, as well as that of the human servant, was reckoned as being the one half of that of the entire animal.

These facts are of interest to us, as significant of the great value set upon the skill of the ophthalmologists of that day, since the surgeon received the same honorarium for the saving of an eye as for the saving of a life. They show the honor in which the faithful physician was held, and also prove to us that even then stringent laws against quackery were necessary.

OPTIC NEURITIS DURING LACTATION, INCLUDING A REFERENCE TO OTHER OCULAR CONDITIONS OBSERVED IN THIS PERIOD.

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OF the several ocular complications which may develop during pregnancy, parturition, and the puerperium, perhaps the most common is albuminuric retinitis, occurring, according to Silex, once in every 3000 cases. Less frequently is uræmic blindness, with or without changes in the fundus oculi, observed. Other factors in the production of loss of vision during this period are furnished by the rare hysterical amauroses ascribed to the trauma of delivery, by retinal separation, by hemorrhage into the ocular tissues, by ischæmia of the retina, due in some cases to ante- or post-partum hemorrhage and in others to alleged reflex contraction of the intraocular vessels. Finally in cases of puerperal sepsis we may have severe metastatic ocular infections.

Many writers during the past century have ascribed various ocular disturbances to the influence of lactation, and, before entering upon the main subject of this paper, it may be of interest to enumerate the pathological conditions for which this apparently harmless function is held responsible. Middlemore,[3] in the edition of his text-book, published in 1835, speaks of conjunctivitis and blepharitis due to this cause; Nasse,[2] 1840, ascribes to it certain cases of keratitis of a mild type. Godo,[4] more recently, has observed herpes

corneæ; Jacobson,[5] choroiditis; Mooren,[6] choroiditis, vitreous opacities, and cataract, all in one case. Bistis[7] has seen iritis; Jocqs,[8] acute dacryo-adenitis, while Leber[9] reports night blindness in a woman who had nursed her child for fifteen months. Paralyses of the ocular muscles are also mentioned, as we shall see later.

Hutchinson,[10] Collins,[12] and Critchett[13] have reported a number of cases of accommodative weakness in nursing women, occurring for the most part in those who were not robust. The asthenopia could always be relieved by the use of convex glasses. That a latent hypermetropia may become manifest is also recognized, and has been seen by the writer in several cases.

By far the most interesting and important division of the subject is formed by the class of cases in which, during secretion of the milk or following protracted nursing, there comes a decided loss of vision, even to complete amaurosis, in one or both eyes, followed in a short time by improvement and not infrequently by a complete restoration of the visual function. That these cases are due to a pathological condition of the optic nerve has been recognized since the invention of the ophthalmoscope. The following case was observed by the writer:

Mrs. E. T., born in Ireland twenty-five years ago, presented herself at the Massachusetts Charitable Eye and Ear Infirmary, on September 4, 1904, and gave the following history. She had always been strong and well except for the usual children's diseases; no history of syphilis. She never had any previous trouble with her eyes except that eighteen months ago some hot water spurted into the right one and she was unable to use it for two weeks.

Seven weeks before coming to the hospital she had been delivered of her first baby, which she nursed. For the past two weeks the sight in her left eye had been failing, and during the last four days it had diminished rapidly. She had been troubled also with frontal headache, more marked on the left side. Her general health had continued normal.

The patient was a well developed, robust woman, with good coloring of the skin and mucous membranes. O.D.V., $\frac{6}{6}$

O.S.V., counted fingers at two metres; not improved by glass. Pupils of equal size and reacted equally. O.D. showed nothing abnormal. Examination of left eye showed cornea, iris, and transparent media normal. The optic disc seemed somewhat hyperæmic, the veins engorged, and the outlines slightly blurred. Visual field contracted. Patient could not recognize colors with this eye. Refraction under homatropin showed emmetropia. The baby appeared strong and healthy. A second examination, which confirmed the first, was made on the afternoon of the same day, and a number of tests for simulation were carried out with negative result. A diagnosis was deferred, and the patient directed to report in a few days' time for further observation. ℞ Potass. iodidi., gr. x. t. i. d.

As Mrs. T. did not return, I wrote inquiring as to her condition, and she answered my letter by coming to the Infirmary on October 6th, thirty-three days after her first visit. According to her account, her sight had begun to improve a few days after her first visit to the hospital, and at the end of about three weeks she thought she could see as well with the left eye as with the right. During the last few days the right had apparently failed slightly. O.S.V., $\frac{6}{6}$, visual field normal, color perception good. O.D.V., $\frac{6}{12}$, slightly improved by plus 0.50 cyl. axis 90. Field and color vision normal. With the ophthalmoscope, nothing pathological could be made out of either fundus. A careful physical examination, kindly made at this time by Dr. J. H. Pratt, of the Massachusetts General Hospital, showed nothing abnormal. Urine normal. The patient was in good health and still nursed her baby. The diagnosis of a pre-existing *retrobulbar neuritis* O.S. was made, and the patient given a tonic and advised to wean her baby, as it seemed possible that the same condition was developing in the right eye. Although told to report soon again, she did not, and I have been unable to obtain her later history.

As hysteria can be excluded in this case by the absence of any of the characteristic signs, by the unilateral character of the process, by the progressive loss of vision and return to normal, and by the totally negative result of the simulation tests, it seems certain that the loss of vision was caused by a mild neuritis situated in the retro-ocular portion of the nerve, the signs of which appeared only in a slight degree at the level of the disc. It is not improbable that definite

atrophic change would have been apparent at a later examination could one have been made, though such a process can take place without sign at the disc in any stage. Characteristic of these cases are the frontal headache and the rapid progressive loss of vision. It is also worthy of note that in three monocular cases of this affection, to be spoken of later (those of Axenfeld, Heinzel, and Schmidt-Rimpler), a retrobulbar neuritis existed, while the binocular cases have usually shown a papillitis. The writer regrets that a central scotoma was not carefully sought for in the above case. The superficial examination of the field with the hand gave no evidence of one.

The earliest text-book on the eye, to which I have access (Beer,[14] 1817), refers to the amaurosis of lactation in a chapter entitled, "Concerning the Vicarious Black Cataract which Follows a Sudden Suppression of the Milk Secretion." I quote his opening paragraph:

"One of the rarest forms of black cataract is that which comes on after a sudden suppression of the milk secretion, accompanied by excruciating frontal pain, terrifying flashes of light, inconsiderable enlargement of the pupils, and by a very slight irregularity of the border of the rigid, swollen, and discolored iris. It is characterized by great photophobia, marked stasis in the conjunctival vessels, and a slight cloudiness of the transparent media of the eye. At first there is only an unimportant loss of vision, but later, a sudden and complete blindness develops. The mammary glands, formerly distended with milk, are now pendant and empty." Cases of a somewhat similar nature were also recognized by Carron du Villards,[15] Himly,[16] Lawrence,[17] and Deval,[18] likewise in the pre-ophthalmoscopic era. Mackenzie,[19] in the French edition of his text-book, published in 1856, devotes considerable space to the subject, describing the disease as occurring in women over thirty years of age who had borne several children. One or both eyes could be affected and the vision could sink to complete amaurosis. Mackenzie believed the process to be a chronic retinitis, and advised weaning as the best treatment. Critchett, on the other hand, was of the opinion that a sub- or supra-retinal

hemorrhage was the important factor. Gibbon,[20] in 1859, reported a case at some length, but unfortunately the ophthalmoscopic examination is lacking. Following him came Hutchinson [11] and Nettleship [21] with a number of cases which are of great interest but incomplete, as, apparently, in but one of these was the disease observed in the acute stage. Fortunately there have been a number of more recent cases, observed throughout their duration, which are briefly summarized below.

Case 1. (Pflüger [22])—Frau G., thirty-five years old, had nursed her third child since its birth three weeks previously. For two weeks she had suffered with supraorbital neuralgia on the right side, and with a dull pain over her whole head, most marked deep in the orbits. There had been a progressive loss of vision. Examination showed a double papillitis with complete loss of vision. The sight rose to normal in nine weeks' time.

Case 2. (Pflüger)—Frau L., twenty-one years old, gave birth four months before to a baby which she had nursed since that time. She complained of blindness in the right eye which, she said, came on suddenly. Examination showed total amaurosis O.D. The optic disc appeared much paler and somewhat more opaque than normal, arteries contracted. One week later, the vision in the left eye began to fail rapidly. Left disc also white and the arteries small, though not so marked as in the right eye. The patient was very anæmic. Improvement soon took place, and at the end of four months V.O.D. equalled $\frac{20}{100}$, V.O.S $\frac{20}{40}$.

Case 3. (Pflüger)—Frau S., twenty-six years of age, had been confined eight weeks before, and had never regained her strength. Two weeks after her confinement, the vision of the right eye had begun to diminish. V.O.D. equalled $\frac{1}{100}$, V.O.S. normal. Well marked papillitis on the right side. In six weeks, V.O.D. normal. This case was later complicated by an otitis interna, a facial erysipelas, and an abscess of the scalp.

Case 4. (Nettleship[21])—The patient was nursing her first child, six months old. With the right eye she could scarcely count fingers, and the ophthalmoscope showed a marked papillitis. Left eye normal. In seven weeks, V.O.D. had improved to normal, while the disc showed a certain amount of atrophy.

CASE 5. (Rogman[23])—The patient, a pale, weak woman, thirty years of age, had given birth to five children. Two weeks after the birth of her youngest child, whom she was nursing, she was taken with a chill and suppression of milk secretion, also headache, vomiting, and a diminution of vision. Five months later, examination showed a typical papillitis in each eye, also homonymous diplopia from paralysis of the external rectus. V.O.D., $\frac{5}{60}$; V.O.S., $\frac{5}{30}$. Vision did not improve in the right eye, but in the left it rose to $\frac{5}{6}$. Patient stated that after each previous confinement she had had a similar febrile attack with disturbance of vision, once complicated by a facial paralysis, and another time by a diplopia.

CASE 6. (Heinzel[24])—The patient, twenty-five years old, had been nursing her first child, born seven weeks before. During a few days she had had pain in her forehead and gradual loss of vision. Well developed and nourished woman; physical examination negative, a trace of albumen in the urine probably due to the lochia. O.D., completely amaurotic. V.O.S., perception of light. The ophthalmoscope showed a moderate papillitis in each eye. Field of vision contracted; no central scotoma. Two months later, the vision was almost normal, and the discs showed signs of slight atrophy.

CASE 7. (Heinzel[25])—Frau H., thirty-four years of age, always well except for anæmia and dysmenorrhœa. Seven weeks after the birth of her first child, she was taken with headache, pain in the orbits, and loss of sight, first in the left and then in the right eye. Pressure on the eyeballs showed deep orbital tenderness; the discs were discolored, somewhat swollen, and slightly infiltrated. The veins were dilated. Vision only light perception. Some months later, the vision was nearly normal, and the discs showed some signs of atrophy. The patient developed mental disease.

CASE 8. (Heinzel[25])—Frau F., twenty-two years old, pale and of weak physique, gave birth seven weeks ago to a two months' premature infant, and lost a considerable amount of blood at the time. The child was nursed only once as it died soon after birth, but the milk secretion continued until recently. She complains of a diminution in the vision of her right eye. V.O.D., $\frac{5}{12}$; V.O.S., $\frac{5}{6}$. Visual field O.D. contracted with a scotoma for red and green. The ophthalmoscope showed both optic discs and the

surrounding retina to be somewhat opaque, the veins dilated and tortuous. One month later, the vision O.D. had sunk to $\frac{6}{18}$. The case was not observed further.

CASE 9. (Heinzel[35])—Frau G., thirty-eight years old, general health good. Several days after the birth of her third child she noticed a loss of vision, then, two or three times a day, attacks of total blindness. Two weeks after parturition, V.O.D., $\frac{4}{8}$; V.O.S., $\frac{4}{8}$. Marked optic neuritis in each eye with some involvement of the retina. At the end of three months, the vision was $\frac{6}{6}$ in each eye.

CASE 10. (Axenfeld[36])—The thirty-seven-year-old patient was taken in the eighth week of lactation with chills, headache, and pain in the left orbit. Complete blindness developed in the left eye in twenty-four hours. At the end of five days there were the signs of a retro-ocular neuritis. Gradual improvement though a central scotoma remained.

CASE 11. (Schmidt-Rimpler[37])—A woman, twenty-four years old, had nursed her child for fourteen months and then weaned it, as she had lost weight rapidly. Two weeks before coming to the clinic, she noticed that the sight of her left eye was failing. Physical examination showed absolutely nothing abnormal. With the left eye she counted fingers in $\frac{1}{2}m$. Large central scotoma. The optic disc appeared somewhat paler than normal, the borders blurred. In six weeks the vision was nearly normal, the scotoma had almost disappeared. The disc was pale on the temporal side.

CASE 12. (Schanz[38])—Patient twenty-two years old. Three weeks after the birth of her sixth child she underwent a considerable exposure, and one week later she noticed a falling off in the vision of the right eye. In three days both eyes were totally blind, and she was taken with chills, headache, and dizziness, the right arm became numb, there was a loss of power in the arm and hand, followed by involvement of the left arm and right leg. Ophthalmoscopic examination showed a double optic neuritis. Death ensued.

CASE 13. (Bistis[7])—The patient, three years previously, while nursing her third child, noticed a considerable loss of sight. She could see hand movements at a distance of five metres. The optic discs were swollen and opaque, the veins dilated, and the arteries contracted. One month later, there was an improvement

in the physical signs, the vision rose and gradually returned to normal. Now, in the last days of her fourth pregnancy, she notices a similar loss of sight; can count fingers in four metres. There is an optic neuritis as in the former attack. No signs of renal disease or syphilis.

Although it is not possible to draw hard and fast conclusions from such a small number of observations, yet a certain amount of valuable information may be obtained from a summary of the fourteen cases cited above, and from some ten others of which we have incomplete records. The average age thus appears to be twenty-nine and a fraction years, the youngest patient being twenty-one and the oldest forty-two. About one-half were in the third decade, with the other half in the fourth. Primiparæ and multiparæ seem to be affected with equal frequency. Usually there is but a single attack, although several cases give a history of diminished vision after each pregnancy. The disease affects strong, healthy women as frequently as it does those who are less robust. In practically all cases the eyes were said to be previously healthy. The seventh week was the time of election for the process to begin, but it varied in wide limits, from shortly before birth to over a year after it.

Establishment of the milk secretion, not actual nursing, is regarded as the important factor in the production of the disease, for in one case the child was premature and died, while in another it was only nursed once, dying a short time after birth. Suppression of the milk secretion, coincident with the onset of the disease, has been reported twice. Occasionally the patient has given a history of protracted nursing, but in a large majority of cases lactation has been entirely within normal limits. Both eyes are more commonly affected than one alone, and it is interesting to note that the monocular cases seem more prone to develop a retrobulbar neuritis than a papillitis. To account for this monocular, retrobulbar type, we might assume the exciting cause to be less active.

Ophthalmoscopic examination shows the loss of vision to be due to an inflammation of the optic nerve, the signs of which are more or less apparent at the disc. Generally

we have a well marked papillitis, occasionally one of extreme severity, with extension of the process into the surrounding retina, while in the retrobulbar type there may be no visible sign of inflammation, although total blindness exists. Atrophy of a varying degree usually results, but may be absent.

The amount of visual diminution varies greatly, but commonly reaches a considerable degree, even to absolute blindness. The loss is rapid and progressive, and may reach its lowest point in forty-eight hours or not for several weeks. The improvement also may be surprisingly rapid, or may extend over several months. The vision bears no relationship to the severity of the process as shown by the ophthalmoscope, since almost normal sight may be noted in spite of a well marked papillitis, while total blindness has been observed without changes visible to the eye. In a corresponding manner, the vision tends to regain its normal acuteness notwithstanding the development of atrophic changes. The visual field is ordinarily contracted and, in the retrobulbar type, is likely to show a central scotoma. Certain cases of the disease have shown a tendency to recurrence during each succeeding pregnancy, and in these, at the end of several attacks, there is likely to be a permanent diminution of sight. Frontal headache is a constant precursor of the disease. The pain is often localized in the orbit, and deep tenderness may be elicited by pressure on the eyeball, while movement of the eye may cause considerable discomfort.

Although, as a rule, general disease does not accompany this affection, yet certain cases have shown an acute onset with headache, chills, fever, vomiting, and general malaise. It seems to be in such cases that suppression of the milk secretion is apt to occur.

As there is nothing peculiar in the structure of the optic nerve which would lead us to suppose that it alone is liable to disease during the period of lactation, we would expect to find manifestations of this obscure process occurring in other nerve tissues of the body. Such is the case. Rogman's patient showed abducens paralysis and gave a history of diplopia during one of her previous attacks and facial

paralysis during another. Schanz's case developed a severe polyneuritis affecting both motor and sensory nerves and ending in death. Handford [29] reports a case, in which, during the puerperium, there were double ptosis and convergent strabismus; the pupils reacted neither to light nor to accommodation. There was no involvement of the optic nerves. Vision was normal. Cases of so-called puerperal neuritis, though rare, have been reported. Eulenburg, [30] in 1895, collected together thirty-four of these in which mechanical and operative causes during labor could be excluded, and divided them into two types: one, mild and localized; the other, diffuse and severe. The first of these generally confines itself to a single area, often the brachial; recovery is rapid and the function of the part completely restored. The second is characterized by a severe polyneuritis, and not infrequently terminates in death. The process occurs after normal parturition without subsequent uterine infection or any other complication which can be discovered, and the etiology is obscure. Although occurring, as a rule, somewhat sooner after parturition than do the cases of optic neuritis, it seems logical to assume a close relationship between the two processes.

Coming now to the etiology of our cases, we find many opinions expressed but very little that is definitely known. Beer and Himly regarded it as due to a sudden suppression of the milk secretion, analogous to menstrual suppression, in which optic neuritis has also been observed. Obviously this can only be of importance in a very few cases, as, in the vast majority, there was no suppression. It is much more likely, as Groenouw points out, that the milk suppression (as in the cases of Rogman and Axenfeld) and the optic neuritis are dependent upon a common cause. Deval believed the process to be of purely nervous origin. Berger [31] assumes an infection with bacteria from the genitalia (although no primary focus has been found). Cohn [32] is of the opinion that, in these cases, a latent neuritis exists during pregnancy and becomes active when the strength is sapped by lactation. This may be excluded by the cases in which the act of nursing was performed only for a very short time

or not at all, and by those in which the process did not set in until many months after pregnancy.

Knies,[33] Schmidt-Rimpler, and Nettleship believe that the loss of strength and chronic anæmia of prolonged lactation form a favoring moment, and certainly this may account for several of the reported cases, notably Schmidt-Rimpler's, where nursing continued for over a year; and one of Nettleship's, in which the patient nursed her child for eighteen months while she was enduring the hardships of the Indian Mutiny. That it will not explain the occurrence of the disease in women, strong and healthy, with no sign of anæmia, is also evident.

The auto-intoxication theory, emanating from Heinzel, is supported as the most likely explanation by Groenouw, Schanz, Bistis, Terrien,[34] and presumably by Fuchs, from whose clinic Heinzel's cases were reported. Heinzel reasons as follows: We know that the optic nerve is peculiarly susceptible to the action of certain poisons, organic and inorganic. It may be affected by lead, arsenic, alcohol, quinine, and tobacco. We may also see an optic neuritis during the course of infectious diseases, supposedly due to the action of the specific toxin of the disease. Why, then, cannot our cases be caused by tox-albumens formed at this time, and in some way dependent for their formation on the secretion of the milk? To the support of this theory he brings the experiments of Wagemann,[35] who found that in bitches, during the lactation period, there was a greater destruction of albuminous substances than would be expected for the nourishment of the body and the formation of milk. Heinzel suggests that these superfluous products may enter into the formation of tox-albumens. Eulenburg speaks of auto-intoxication as a possible cause of puerperal neuritis, as does also Möbius.[36] An auto-intoxication can certainly not be ruled out of the question, and it must, in the absence of a more probable one, be accepted as the leading theory.

What proof have we, then, that the secretion of the milk plays an important part in relation to the disease? First and foremost, this belief has been accepted through several generations, though, on looking back, we find little proof

to substantiate it. True, several authors have stated, more especially in regard to the external diseases of the eye, that these affections are extremely resistent to treatment unless nursing is discontinued. This class of cases, however, has been of the phlyctenular type, to which the weaker members of the community are especially prone, and nursing is a drain on the system, to withstand which a normal condition of health is required. No wonder, then, that weaning, by husbanding the strength of the individual, will have a favorable influence on the disease. We know, too, that, without resorting to it, several of the cases of optic neuritis have shown a rapid and complete recovery.

As mentioned above, Heinzel suggests the formation of tox-albumens as a result of the increased destruction of albuminous substances during lactation, found by Wagemann. Without presuming to question the latter's results, it must be remembered that his work was performed on but two animals. Obviously, until further investigation has confirmed his findings, we can only regard them as suggestive.

Again, if lactation predisposes to optic neuritis, why do we not see cases of it more frequently? It is not rare to observe this disease in men, children, and nulliparæ where no apparent cause can be discovered, and in these cases the secreting of milk can play no part. If not dependent on lactation, we should expect the process to occur proportionately as often in nursing women as it does in those who have never secreted milk, and that is what probably does occur, although we have no statistics to prove it. It certainly is not observed oftener during lactation than at other times unless many cases are overlooked. It is suggestive to note that the secreting of milk has never, to the writer's knowledge, been connected with puerperal neuritis by the neurologists.

It should be emphasized, then, that there is little evidence to connect this affection with lactation, and that the term, lactation indicates simply, in the absence of a better term the characteristic by which these cases may be most easily recognized.

Being still in the dark as to the cause of this obscure affection, treatment must be on general lines. We should eliminate possible toxic substances from the body. We should increase the power of resistance in every way at our command. To this end weaning should be advised. Recurrent attacks should be watched for carefully.

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PRESBYOPIA AT AN EARLY AGE. ASTIGMATIC ACCOMMODATION UNDER THE INFLUENCE OF ESERINE.

By. Prof. W. KOSTER-GZN, of Leyden.

Translated from the German Edition for March, 1904, by Dr. Matthias Lanckton Foster.

ONE day while engaged in a demonstration of cyclitic deposits on the posterior surface of the cornea, I found that one of the students, Mr. T., could not see them with the unaided eye. He was twenty-seven years old. For several years he had noticed that he could not bring his book near his eyes while he was reading, and he had experienced such slight signs of presbyopic asthenopia as a feeling of heaviness of the lids and a little fatigue of the eyes, but had not felt sufficient annoyance to impel him to consult an ophthalmologist until I thus accidentally discovered his condition.

His refraction was R V, $\frac{6}{6}$; $\frac{6}{6}$ with + .75 cyl. axis 3° temporal. L V, $\frac{6}{6}$; emmetropia. The near point was at 25*cm*, even when one eye was covered. It was evident that he made strong efforts to accommodate for nearer points from the convergence of his eyes, which was even more marked when one eye was covered, and that something abnormal was present to account for the fact that he had an amplitude of accommodation of only four dioptries instead of 7.5 which would correspond to his age. The condition of his accommodation was what would normally be expected at the age of forty-five.

Naturally my first thought was of latent hypermetropia.

The existence of this was improbable on account of the absence of any manifest hypermetropia or of marked accommodative asthenopia, which is to be expected from a constant accommodative effort of 3.50 dioptries at the age of twenty-seven, but to exclude it with certainty the accommodation was paralyzed with homatropine and a condition of emmetropia demonstrated with both the retinoscope and ophthalmoscope.

There was no particular reason why simulation should be suspected, but I satisfied myself, both at the time of the first examination and often subsequently by the interposition of positive and negative lenses, that there were no variations in his statements.

The absence of marked asthenopia in spite of considerable reading shows that this was not a case of paresis of the accommodation. In paresis of the accommodation, an effort of 4 dioptries is sometimes possible, but it can be maintained for only a short time and is accompanied by an unpleasant feeling of asthenopia because it requires the maximum innervation. Besides, this great effort to accommodate a few dioptries is often possible only when associated with such a degree of convergence as to produce strabismus and diplopia. In presbyopes, on the contrary, who still accommodate 4 dioptries, these symptoms are wanting, while the changes still permitted in the lens take place with no greater tension than formerly, and it is only when a disproportionately strong innervation is used that slight asthenopic symptoms appear. Moreover, in this case there were no pupillary signs of paresis, there was no micropia when looking at near objects with one eye, no cause which might produce paresis of the accommodation could be found, and the condition remained unchanged during a period of observation extending over twelve months.

The lens appeared to be normal throughout.

The possibility of a commencing glaucoma simplex was considered, although not suggested by the history, but no trace of this disease could be found or has yet appeared. I may say in passing that I believe the slight amplitude of accommodation almost always present in the early stage

of glaucoma simplex is due to a paresis of the accommodation. We cannot as yet determine whether it is caused by an ophthalmoplegia interna or by changes in the ciliary muscle, but probably both factors take part. It is certain, however, that patients with glaucoma use the remains of their accommodation with the same difficulty as patients with paresis, while presbyopes accommodate with ease to the extent they possess the function. The fact that glaucoma simplex often appears about the fortieth year may explain why in many text-books this disturbance of the accommodation is called early presbyopia.

There was no resemblance in this case to the disturbances of the accommodation which have been observed in general diseases. The latter may be divided into two groups: paresis and weakness of the accommodation. To the first group belong the accommodative asthenopias met with in patients with icterus and in cases of poisoning with lead, alcohol, tobacco, or the products of metabolism, in all of which there is a true abbreviation of the amplitude of accommodation. To the second group belong all those cases in which the amplitude is not abbreviated, but the accommodative effort cannot long be maintained, a condition often observed in anæmia from very diverse causes, in neurasthenia and hysteria. None of these anomalies presents the same combination of symptoms as that shown in presbyopia, while up to the time of my examination Mr. T. had enjoyed good health, and particularly had never suffered from any of the troubles known to impair the accommodation.

Finally, there was no intoxication with a mydriatic taken internally or otherwise. Such an intoxication would have shown itself as a paresis of the accommodation with dilated pupils.

From a clinical standpoint, this was certainly a case of presbyopia at an early age in a perfectly healthy man.

I have been unable to find in literature a description of a case similar to this. I have not been able to read Landesberg's article in the original, but from the brief review I have read I judge that he dealt with weakness of the accommodation in an enfeebled person. Jacobson told of a

disturbance of the accommodation caused by toothache, Belawsky of paresis of the accommodation in scurvy. Theobald described cases of asthenopia with subnormal accommodation power in comparatively young people, and thought the cause of the trouble was weakness of the ciliary muscle, or imperfect elasticity of the lens. But his observation that these patients could read books close to their eyes makes it more than doubtful whether presbyopia was present. Nothing else have I found.

Perhaps the extreme rarity of this case may be due to the fact that the annoyance caused is so slight that the advice of an ophthalmologist would not be sought. It may be that a systematic examination of a thousand young persons would reveal a similar case.

An attempt was now made to ascertain the nature of the disturbance of the accommodation in this case, and the indication seemed to be to produce a strong contraction of the ciliary muscle. For this purpose, a drop of a one-per-cent. solution of eserine sulphate was placed in the conjunctival sac of the emmetropic left eye. This produced a peculiar contraction of the pupil, which became oval and displaced upward, as if the myotic had acted on a circumscribed part of the iris below. A slight degree of this symptom may frequently be seen when the myotic passes, by diffusion, through the lower part of the cornea and sclera, and so first reaches the lower part of the iris and ciliary body. The markedly oval form in this case, at one time *2mm* by *4mm*, seems to indicate that after the muscular spasm reached a certain degree an unusual resistance had to be overcome before the contraction of the tissue could begin. After half an hour the pupil was contracted and circular. The refraction of the eye, on account of the spasm of the ciliary muscle, was 3.50 dioptries, later 4, and still later 4.50 dioptries. A higher degree of myopia could not be induced. The near point at first was *25cm*, a position which corresponded to that of the far point during the spasm. At the end of an hour, the near point was at *14cm* as determined with fine print, at *12cm* as determined with a fine, illuminated hole. Thus the voluntary accommodative effort made in

that stage of the spasm caused by the eserine was able to contract the ciliary muscle so strongly as almost to reach the normal amplitude. A repetition of this experiment, several weeks later, gave the same result. These conclusions may be drawn:

First, the curtailment of the amplitude of accommodation in this case cannot be ascribed to any change in the lens, because the lens could attain the convexity which corresponded to the age. The very small size of the pupil did not vitiate the result of the examination in this regard, because when a diaphragm with an aperture 1.75*mm* in diameter, the minimum size of the pupil produced by eserine, was placed before the eye in its ordinary condition, the near point was at 22*cm*, which showed 4.50 dioptries of accommodation.

Second, the ciliary muscle was well developed. Otherwise it would be difficult to understand how, under unusual conditions, it could contract sufficiently for the maximum amplitude of accommodation to manifest itself. Yet it cannot be denied that a poorly developed muscle is in a condition to produce for a moment a great effort under the impulse of a strong innervation when its fibres have been made receptive by eserine. With a poorly developed muscle and otherwise normal conditions, the amplitude of accommodation would become greater, even if it did not reach the normal, but there would undoubtedly be present asthenopia and symptoms of muscular paresis. But as the asthenopic symptoms were very slight in this case, the muscle must have been well developed.

There seems to be only one possible explanation. The lens and ciliary muscle were normal, but during contraction of the muscle, or perhaps during contraction of the circular zone in which the zonule of Zinn is inserted, an abnormal resistance was met with at a certain point, which could not be overcome by the usual innervation alone, but could be with the aid of eserine. The iris presented a similar condition. One pupil contracted to the maximum in response to strong convergence, the other maintained a diameter of 5*mm*, yet eserine produced maximum myosis in both. I

have mentioned above, the peculiar symptoms produced in the iris by the action of the eserine, which indicated a rigidity of the tissue, as well as a like condition of the ciliary body. It is difficult to determine the nature of this resistance to the contraction of the ciliary muscle. We may imagine the limitation of movements to be due to results of a past inflammation, to an accidental anatomical condition, or to impaired mobility of the ciliary body, either on account of faults in the stroma or of special conditions of the blood-vessels, but this is an unnatural hypothesis, with little foundation.

The explanation which I have adopted, that it was a case of early presbyopia, is unforced and based on the ascertained facts. If it is correct, the amplitude of accommodation will remain the same until Mr. T. is forty-two years old. That there was no change in the condition during a year proves something, but not much; the case should be watched longer. If, contrary to my opinion, the cause should prove to be weakness of the ciliary muscle, the amplitude of accommodation will undergo changes, and accommodative asthenopia in particular will become marked.

Finally, the name of the diagnosis may be questioned, because there were no such changes in the lens as accompany presbyopia. Doubtless something may be said in favor of calling the diagnosis "restriction of accommodation," but this is only the name of a symptom, and, as the clinical picture is that of presbyopia, it seems better to retain that name, so long as the cause of the trouble cannot be determined with certainty.

ASTIGMATIC ACCOMMODATION.

The irregular contraction of the iris already mentioned recalled to mind some experiments I undertook, in 1897, to obtain an asymmetrical effect of atropine on the ciliary muscle. I finally succeeded in doing this, and in producing an astigmatism of 0.75 dioptry, by the local application of a concentrated solution on a bit of cotton, but the experiments were abandoned, because it was evident that, for my

purpose, the known methods of investigation needed to be improved.

In the case of Mr. T., the local action of the eserine was so remarkable that I made an investigation to determine whether lenticular astigmatism could be found at any stage. The following notes were made on March 28, 1900:

L V, $\frac{6}{6}$. Emmetropia. Accommodation, 4 dioptries. Two instillations of one drop each of a 1 % solution of eserine sulphate in the lower conjunctival sac.

After twenty minutes: Near point at 19*cm*. Pupillary diameter, 1.75*mm*. Vision, $\frac{6}{6}$, with — 2.50 dioptries.

After twenty-four minutes: Near point at 15*cm*, a little later at 12*cm* (examinations by means of fine print and a hole in a sheet of black paper). Vision, $\frac{6}{6}$, with — 4.50.

After fifty minutes: Vision, $\frac{6}{18}$; no improvement with spherical lenses, but with — 4.50 ⊂ + 2.50 cyl. axis 5° nasal it became $\frac{6}{8}$.

After fifty-five minutes: Vision, $\frac{6}{12}$; $\frac{6}{8}$ with — 2. cyl. axis horizontal. Near point with — 2. cyl. at 20*cm*.

After one hour: Vision, $\frac{6}{6}$, with — 1. cyl. axis horizontal.

After one hour and twenty minutes: Vision, $\frac{6}{6}$, with — 0.50 cyl. axis horizontal.

After that time, the vision was $\frac{6}{6}$, the eye was emmetropic, and the near point had reached to its former place.

From these notes we see that the eserine produced at first a symmetrical contraction of 2.50 dioptries, so that with correction the vision was $\frac{6}{6}$. But at the end of fifty minutes the vision had fallen to $\frac{6}{18}$; could not be improved except with a sphero-cylindrical lens, and then only to $\frac{6}{8}$. The spasm of the ciliary muscle was evidently changing, and the refraction of the vertical meridian of the lens exceeded that of the horizontal by the important amount of 2.50 dioptries. It is clear that at the beginning of the action of the eserine the greater contraction of the ciliary muscle below balanced the weaker action on each side, and so caused a spherical increase in the refraction of the lens, while in the stage in which astigmatism was observed, the lateral action had begun to diminish, or at least overbalanced the contraction below. Perhaps at the time of instillation a momentary

asymmetrical contraction of the muscle was produced, which escaped observation.

Along with this asymmetric action of eserine, particularly when the lenticular astigmatism could be demonstrated, the entire lens, or better, the centre of the lens, must have been moved a little upward, as there was great tension of the zonule below, while above it was normal. The lateral bands of the zonule must accordingly have been directed a little upward, and it is very probable that their tension on the lens created a little irregular astigmatism of its anterior and posterior surfaces, an idea which is favored by the fact that the vision could not be brought up to $\frac{6}{6}$.

It is peculiar that, in this case, the eserine did not spread more and more in the anterior chamber and the muscle, so as to produce a greater general action on the ciliary muscle. We have seen that after a while its action ceased in the horizontal meridian, while it continued in the vertical, probably in the lower part alone. There were 2 dioptries of negative astigmatism, with the greatest refraction in the vertical meridian. As the action decreased, the astigmatism sank to 1 dioptry, then to 0.50 dioptry, and finally they again became emmetropic. The astigmatism was studied not only by testing the vision, but also with radiating lines, and Mr. T's answers were always unequivocal.

So far as I have been able to learn, astigmatic accommodation has never before been demonstrated with certainty. Many believe that an eye with corneal astigmatism can correct it by asymmetric accommodation in the opposite meridian, and it has been claimed that a normal eye can overcome a cylindrical lens in the same way, but the experiments and critical objections of Hess show that astigmatic accommodation was not proved in the quoted cases. In this case, error was excluded by the fact that the vision was very poor without the correcting cylinder, a fact which can be explained only by the assumption of an astigmatic curvature of the lens. Hence lenticular astigmatism can result from an asymmetric contraction of the ciliary muscle. This is not the same as saying that when astigmatism is present it can be corrected by voluntary or involuntary accommo-

dation, or that cylindrical glasses can be so neutralized. It only proves that the lens presents no hindrance in its consistency or structure to such a correction. I agree with Hess that the possibility of such a correction has not yet been shown, and I believe it to be very improbable, because if the normal person cannot accommodate unequally with the two eyes when the accommodation of one has been rendered slightly paretic by homatropine, an asymmetric innervation of one and the same ciliary muscle is not to be expected. Possibly the ability to accommodate unequally with the two eyes and with different parts of the same eye may be developed by long practice, but this has not been proven. To get this proof, it would be necessary to proceed along the same lines in which various seekers have toiled with less fortunate results, and first of all to gather evidence from anisometropes and persons with astigmatism. As Hess has pointed out, great care is necessary in drawing conclusions.

What has been said may be thus summarized:

1. Artificial astigmatic contraction of the ciliary muscle produces asymmetric accommodation in the corresponding meridians.

2. The apparatus of accommodation interposes no difficulty in the way of the hypothesis that astigmatic accommodation may take place under the influence of normal innervation.

AN EXPERIMENTAL STUDY OF THE HEALING OF PERFORATING INCISED WOUNDS OF THE CORNEA.

By Dr. A. WEINSTEIN, St. Petersburg.

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(*With seven figures on appended Plates I. to IV.*)

Chapter I.—*The development and structure of the cornea.*

ALL theories in regard to the development of the human eye are based on comparative embryology. In birds and mammals, the primary optic vesicles first appear as two hollow offshoots from the lateral walls of the primary anterior cerebral vesicle. As these grow, their bases contract until they form two narrow tubes, later the optic nerves, connected with the ventricles of the brain. The optic vesicles then undergo complicated changes which result in the formation of the lens, vitreous, and secondary optic vesicle. The entire vesicular system lies in the mesoderm, from which the vitreous, cornea, sclera, and choroid are differentiated at a later period. The retina with its pigment membrane, the ciliary body, and iris are developed from the walls of the optic vesicle, while from the ectoderm come the lens and the epithelium of the anterior surface of the cornea. The origin of the cornea yet remains a subject of dispute, although it has been studied much during the past thirty years; but this fact has been established, that it comes from the mesoderm and has nothing to do with the optic vesicle.

Kessler represents the first foundation of the cornea as an amorphous layer, which was thought to be an exudate of the primordial epithelial cells. Mesodermal cells appear later in this structureless layer and divide it into two lamellæ, the anterior Bowman's membrane, the posterior Descemet's membrane, while the mesodermal cells themselves are changed into the fixed corneal cells.

Kölliker, Lieberkuhn, and most embryologists of the present day hold a different view, according to which the mesodermal cells press in between the lens and the epithelium and separate the former from its matrix. The anterior thicker part of this layer is changed into the substantia propria of the cornea, while the posterior thinner portion takes part in the formation of the vascular lens capsule. The mesodermal layer between the lens and the ectoderm thickens and then divides into two lamellæ, the inner, thin layer becoming the pupillary membrane, the outer the corneal tissue. Between these a space appears which gradually enlarges, its walls become covered with endothelium, and finally it becomes the anterior chamber.

About this time the first traces of the iris appear. The layer of cells on the posterior surface of the cornea represents the epithelium of Descemet's membrane. Simultaneously with the formation of the conjunctiva, the anterior surface of the cornea becomes covered with epithelium which, according to Nussbaum, is at first composed of a lower layer of cuboidal and an upper of flat cells. The corneal tissue appears homogeneous and composed of cells and intercellular substance. The cells have at first a certain thickness, but later change into thin plates. In the human fœtus the cornea becomes transparent in the early part of the fourth month. According to Kollmann, the anterior chamber was to be plainly seen in the human embryo *21mm* long as a cleft lined with mesodermal cells which were later to become endothelium. According to Kölliker, in an eight-weeks'-old embryo the cornea had been differentiated into pupillary membrane and cornea propria, and the anterior chamber formed. Yet Nussbaum found that Descemet's membrane could not be clearly distinguished in a human

embryo five months old, and authors differ in their explanations of this.

The origins of the epithelium, of the corneal tissue proper, and of the endothelium have been satisfactorily determined, but that of Descemet's membrane has not, and as the question of its origin is intimately associated with that of its ability to regenerate, it is necessary for me to consider it in detail. This in turn necessitates the consideration of the origin of the lens capsule, because many authors base their opinions in regard to the origin of Descemet's membrane upon analogy with that of the capsule. Kessler and Hertwig consider both these limiting membranes as the remains of an amorphous mass which forms the primordial trace of the cornea, and is a secretory product of the ectodermal cells, a view which is not held by most authors. As to the origin of the anterior limiting membrane, it is agreed that it is the compact anterior portion of the ground substance of the cornea.

One view regarding Descemet's membrane is that it is a cuticular formation, a secretory product of the endothelial cells, based on analogy with the structureless lens capsule; another is that both hyaline membranes are of mesoblastic origin. Manz quotes Köllicker's theory that the anterior capsule is a secretory product of the epithelial cells, while as regards the anterior and posterior elastic membranes he considers the anterior simply a limiting membrane of the corneal substance proper, and that the origin of the posterior, which later becomes Descemet's membrane, from the inner endothelium is at least not improbable. Arnold conceived the lens capsule to be a connective-tissue limiting membrane which sprang from the mesoderm. Sernoff held that a little plate of connective tissue was enclosed with the lens at the time of the formation of the latter, and then spread itself about the lens to form the primordial capsule. Babuchin examined Sernoff's specimen of the lens capsule of embryonic chickens and suggested that the capsule was probably of connective-tissue origin and not a secretory product of the cells. Waldeyer also believed the capsule to be of connective-tissue origin.

As to the origin of Descemet's membrane, Arnold says: "If a theory regarding the origin of the lamina elastica anterior and posterior is formed from analogy, these membranes must be accepted as results of a differentiation, the same as between the so-called vascular and the true lens capsule and as in all other limiting membranes." Kölliker at first held the lens capsule to be a cuticular formation, but later said it was either this or was derived from the mesoderm. The same author described Descemet's membrane as an intermediate form between connective and elastic tissue. Nussbaum considered both the lens capsule and Descemet's membrane to be secretory products of cells. Kollmann thought both sprang from the mesoderm. Schwalbe declared that the inner layers of the lens capsule were of cuticular formation, the outer of connective tissue from the vascular membrane of the lens, and that Descemet's membrane was a cuticular formation secreted by the endothelium.

As we look over this mass of contradictory opinions the fact strikes us that the advocates of the secretory theory advance no evidence in its favor, and it is proper to note that it rests not on embryological knowledge, but on probability. If we ask what suggested the idea that the transparent lens capsule was a secretion of the cells, the answer seems to be simply the absence of structure and of formative elements. In support of this theory, Müller states that all hyaline membranes are near epithelial cells. This is all its advocates can bring forward in support of this theory. Formerly it presented nothing extraordinary, but to-day, when intercellular tissue is believed to be of a different origin, its accuracy may be questioned.

Embryology and comparative anatomy show that the cornea comprises in itself the skin, or conjunctiva, the sclera, and the uvea, and its anatomy should correspondingly be divided into three parts—the cutaneous, the scleral, and the uveal, or choroidal. The first is composed of an epithelial layer continuous with the epithelium of the conjunctiva, the connective-tissue stroma of which, together with the blood-vessels, comes only to the limbus and covers a narrow zone at the periphery. Merkel and Kallius add the anterior lim-

iting membrane of Bowman, with a small superficial portion of the substantia propria. The second includes the true corneal tissue, with Reichert's membrane. To the third belong the endothelium and Descemet's membrane. The latter is naturally true only on condition that Descemet's membrane is considered a product of the epithelial cells, an assumption which has not been proved and is denied by many embryologists. In this connection, it is an instructive fact that the fibrous structure of the corneal substance proper has been recognized for a comparatively short time. Thirty years ago, most authors, in spite of Henle's opposition, thought it to be a secretory product of cells, and it was first dissected by Rollet and Schweigger-Seidel after maceration of the cornea in a series of reagents. Tamamscheff demonstrated that the separate layers of Descemet's membrane are composed of very fine fibres, held together by a cement, and that after solution of the latter, the peculiar lustre and elasticity of the membrane disappeared. At the margin of the cornea the fine fibres of Descemet's membrane pass into an elastic network between the canal of Schlemm and the angle of the anterior chamber. The inner surface of Descemet's membrane is covered by a layer of flat polygonal cells cemented together. According to Ciacio and Preiss, there are stomata between these cells which are connected with the serous canaliculi of the substania propria by a system of spaces in Descemet's membrane.

CHAPTER II.—*The regeneration of the epithelium.*

In 1870, Güterbock discovered the sinking of epithelium into a wound, but erroneously ascribed it to transplantation with the knife. Since that time various theories have been advanced to account for it, according to some of which karyokinesis is a factor of chief importance, according to others of secondary importance, while the closing of an epithelial defect is accomplished by an active or passive extension of the adjacent epithelial cells over the wound, and according to still others of no importance whatever. Marchand asserts that the new epithelium is formed through direct nuclear segmentation, while Ranvier advanced the

theory that the regeneration of the epithelium depends on the release by the wound of the deep-lying cells which are in a state of tension like soft, elastic bodies compressed in a sac. Why, if that is the case, the epithelium is not released at once instead of after a comparatively long time, Ranvier does not explain.

All my experiments were performed on full-grown rabbits which had been under observation for some time to determine that their general health was good and their eyes healthy. Peripheral wounds of the cornea in a rabbit always gape unless sutured, and the healing is so interfered with that a series of experiments in which the wounds were made as if for cataract extraction, or iridectomy, were abandoned as fruitless. More satisfactory observations were possible with wounds made by introducing a Graefe knife with its edge turned forward through the cornea near its temporal margin, passing it as far as desired toward the nasal side, making a counterpuncture and cutting out. With few exceptions the wounds were between 4 and *6mm* long. Cases in which the iris became incarcerated were excluded. Some operations were performed under cocaine, others without. This paper deals with the latter only, the others will be considered in another paper on the influence of cocaine upon the process of healing. The rabbits were tied on Czermak's table and the eyes washed with freshly boiled water. No chemical antiseptics were used because they are irritating and because they are chemically antagonistic to leucocytes. Neither speculum nor fixation forceps was used because they are unnecessary and it is desirable not to irritate the conjunctiva, but the lids were held open with the fingers. The knives were new, sterilized in 95 % alcohol and just before use were washed in clean boiled water. Precautions to prevent later contamination of the wounds by the rabbits themselves were found to be unnecessary. Observations were made at the end of 1, 2, 3, 4, 6, 8, 10, and 24 hours, and after 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 30, 45, 60, 90, 105, and 120 days. The eyes were enucleated with great care to prevent injury of the epithelium and placed in a 10 %

formalin and a saturated sublimate solution. They remained in the formalin from 12 to 20 hours, in the sublimate about 24 hours, when they were hardened in alcohol and the sublimate washed away. They were then divided equatorially, the lenses removed,and the anterior sections placed for 24 hours in absolute alcohol, then for 24 hours longer in a mixture of alcohol and ether and then embedded in celloidin. Sections were then made of the entire wound and stained in various ways.

As soon as a perforating incised wound is made in the cornea of a rabbit, the aqueous escapes, and the iris is brought into contact with the posterior surface of the cornea. After from three to five minutes, the anterior chamber can be seen by oblique illumination to be partially reformed, and after from twelve to fifteen minutes to have regained its normal depth. In very small wounds this primary closure may be due to the swelling of the substantia propria so that the severed lamellæ are closely approximated, but larger wounds are closed by a fibrous plug, the origin of which has not yet been made clear. Several theories have been advanced, but a careful examination of the stained specimens, in all of which the plugs consist of networks of fibrin which not only occupy the wound but extend in a fan-like form into the anterior chamber and often reach the iris, shows each to be erroneous. The impression given is that the stream of fluid from the anterior chamber has been coagulated on its way. It is evident that the parenchymatous fluid of the cornea takes no part because it could not enter the anterior chamber against the current, and it is also clear that the surface of the wound cannot influence the coagulability of the aqueous. It has been shown that the normal aqueous is not coagulable because it contains neither albumen nor fibrin factors. These conditions are changed immediately after puncture of the anterior chamber, and this is one of the symptoms of the process of healing. Theories which consider this change a reflex phenomenon produced by a lowering of the intraocular tension, or the destruction of the epithelial layer, are not satisfactory, and at present it seems more probable that

Marchand's theory is correct, that it is brought about by a reflex action pertaining to the region involved. A few hours after the anterior chamber has reformed, the wound is covered with epithelium, and its surface lustrous.

Experiment 1. Weight of rabbit, 1400*g*. Wound, 5*mm* long; 1 hour old.

The clinical observation in each case was made by means of oblique illumination and the aid of a loupe.

The eye was kept open; showed no secretion and no signs of irritation. The anterior chamber was reformed. The wound was closed and covered by a thick layer of fibrin which extended in filaments from the cornea to the inner canthus. The margins of the wound were much swollen and gaped outward. The surrounding cornea was perfectly transparent.

Microscopic examination: The wound presented the appearance of an oblique fissure, narrowest in the anterior third of the cornea propria, wider in front of this point, and wider yet behind. The middle of the anterior dilatation was empty, its walls covered by a coarse mesh of fibrin which extended into and filled the narrowest part of the canal. The posterior dilatation was filled with a fine, delicate mesh of fibrin, which spread fan-like into the anterior chamber and extended to the pupillary margin of the iris. This network was separated everywhere from the cut surface of the cornea propria by thick, winding fibres of fibrin, which were present also in the midst of the network. No formative elements were present in the wound. The cut ends of the lamellæ of the true corneal tissue formed a broken line on each side, but nowhere did the opposing lamellæ touch each other.

On one side the corneal epithelium came to the margin of the wound, on the other it did not. On each side it began at no great distance from the wound to grow thinner as it approached the margin, until it became only one half or a third as thick as normal, and was composed of only two layers of cells, the lower cuboidal, the upper flat. In other specimens the epithelium reached almost to the margin of the wound and looked as if sharply cut off. With few exceptions, mitoses (asters and equatorial plates) were present in small numbers far from the wound and always in the cylindrical cells. The cornea propria about the wound was swollen until its thickness was one and a half times

the normal, its anterior layer bent forward near the wound, the posterior backward. Immediately about the wound, between the bundles of fibres of the cornea propria, were slender nuclei which were intensively stained by hæmatoxylin. There were no leucocytes. The cut ends of Descemet's membrane curved forward. There were no changes in the endothelium which ended before it reached the margin of the incision.

Experiment 2. Weight of rabbit, 1650*g*. Wound, 5*mm* long; 2 hours old.

The wound was closed, its margins were swollen and looked as if they were undermined. The bottom of the wound was gray, dull, and lustreless. The surrounding cornea was clear and there were no signs of irritation. Otherwise the appearance was the same as in the preceding.

Microscopical examination: The margins of the wound were not on the same level, one was higher than the other. The section of the wound was in the form of two triangles with their apices together at a point somewhat in front of the middle of the cornea. The anterior triangle contained fibrin in which were a few polynucleated leucocytes. Isolated leucocytes were present in the cornea propria and the epithelium of the immediate vicinity. The posterior triangle was much larger, and was filled partly by a coarse, partly by a fine, mesh of fibrin, which extended far into the anterior chamber. No formative elements were present. The divided lamellæ of the cornea propria came very close together in the middle, but did not touch, as they were separated by a thin layer of fibrin, which contained some polynucleated leucocytes.

On one side of the wound, the epithelium extended without deformation to, and a little over, the margin. On the other it grew thinner as it approached, so that when it reached the margin it consisted of but a single layer of flat cells. In each section from eleven to twenty mitoses were to be seen, always in the lower layer of the basal cells and at a distance from the wound, the majority on the side where the epithelium overlapped the margin of the wound. Their arrangement was irregular. The forms most frequently seen were asters, equatorial plates, and amphiasters, although wreath- and skein-like forms were also met with. The axis of segmentation was sometimes vertical, sometimes horizontal, sometimes oblique.

In the cornea propria the same changes were present as those

described in the first experiment. The cut ends of Descemet's membrane were at a distance from the wound and very slightly bent forward, so the cornea propria was laid bare for a certain extent. There were no changes in the endothelium.

Experiment 3. Weight of rabbit, 1200*g*. Wound, 6*mm* long; 3 hours old.

The wound was covered with fibrin, the margins swollen and gaping outward. The surrounding cornea was transparent. There were no signs of irritation. Other conditions the same as before.

Under the microscope, the wound was a narrow fissure dilated slightly in front and behind, and filled partly with a coarse, partly with a fine, fibrous mesh, which extended from the wound both anteriorly and posteriorly. No formative elements were present.

On one side the epithelium grew thinner as it approached the wound and ended at some distance from the margin, on the other it was unchanged up to the margin, where it became somewhat pointed. Many mitoses were present, twenty to thirty in a section, strewed irregularly over the entire surface of the cornea, nearly, but not quite, to the margin of the wound. They were mainly in the lower layer of basal cells, but some were found in the middle layer. The most common forms were equatorial plates and maphiasters.

In the cornea propria, not far from the wound, were intensively colored thin nuclei and formative cells, part spindle-shaped, part irregular. On one side the edge of Descemet's membrane overlapped the margin of the wound and was curled forward, on the other it ended some distance away and did not bend forward. There were no changes in the endothelium.

Experiment 4. Weight of rabbit, 1700*g*. Wound, 6*mm* long; 4 hours old.

The wound looked like a gray stripe. Its margins were somewhat swollen and gaped outward. The centre was grooved. Its surface was lustrous. The surrounding cornea was clear. There were no signs of irritation. Other conditions the same as before.

Microscopic picture (Fig. 1. Pl. I.–II.). The wound was a narrow fissure dilated in front, more dilated behind. With the exception of about a quarter of its anterior portion longitudinally, which was filled with epithelium, it was occupied by a delicate

network of fibrin which extended in a fan-like form through the anterior chamber to the iris (Fig. 1, F Pf). In the midst of this fine network were coarse fibres which for the most part ran obliquely and were intensively stained. The cut ends of the lamellæ of the cornea propria extended various distances into the wound and so formed a broken line. They were separated from the fibrin by a fairly thick, winding border line, stained by hæmatoxylin. The lamellæ of the opposite sides nowhere came into contact.

The epithelium (Fig. 1, E Pf) had sunk into the wound from each side for about a quarter of its length and there retained the same characteristics as on the surface of the cornea. The lower layer was composed of cylindrical cells, the middle of irregularly polygonal, and the upper of flat cells. The epithelium from each side of the wound was in contact with that from the other. Its thickness in the wound was somewhat greater than on the surface of the cornea, chiefly on account of the increased length of the cylindrical cells. On the cornea near the wound, the epithelium on one side was thinner than usual, consisting of but two layers of cells, cuboidal and flat, while on the other side it was normal. In other specimens, the epithelium on each side grew thinner as it approached the wound, and that which had sunk into the wound formed two club-shaped thickenings which nowhere touched. The three normal layers of cells, with the cylindricals lengthened, could also be distinguished here. Mitoses (Fig. 1, M) were present both in the epithelium that had sunk into the wound, near the margins of the wound, and over the entire surface of the cornea. Their number varied in different slides, in the wound from one to four, on the surface of the cornea from twelve to twenty-five. They were not arranged in any regular order, in some slides the majority were not far from the wound, in others they were mostly at a considerable distance, while in others they were evenly distributed. Most of them were in the basal cells, but occasionally one was met with in the middle layer. Asters, equatorial plates, and amphiasters were the most frequent forms. The axis of segmentation was sometimes vertical, sometimes horizontal, sometimes oblique.

The cornea propria near the wound was œdematous. The corneal corpuscles were swollen. In some, two, three, or four nuclei lay close together, in others there were one or two karyokinetic figures, always at some distance from the wound. Im-

mediately about the wound, as well as within it beneath the epithelial plug, were some polynucleated leucocytes (Fig. 1, L).

The cut ends of Descemet's membrane (Fig. 1, DD) were retracted from the wound and bent somewhat forward. There were no changes in the endothelium.

Experiment 5. Weight of rabbit, 1700*g*. Wound, 6*mm* long; 6 hours old.

The wound had the appearance of a gray groove with lustrous surface. The surrounding cornea was clear. Other conditions the same as before.

Under the microscope the wound had the form of a narrow fissure dilated somewhat anteriorly and posteriorly. The anterior portion was filled with epithelium, the posterior with a fine mesh of fibrin in which were several polynuclear leucocytes. The epithelium in the wound generally retained its normal structure. On the surface of the cornea near the wound it was rather thin, as the lower cells had assumed a cuboidal form. Mitoses were present in the epithelium, both in the wound and over the entire surface of the cornea, with the aster and amphiaster forms prevailing, in both the lower and middle layers. No regularity in the segmentation could be made out.

In the cornea propria, both near the wound and at some distance from it, long and short spindle-shaped cells could be seen between the bundles of fibres in the superficial and middle layers. Some of these cells were stained badly and had no nuclei, others had one, two, three, four, or more nuclei lying in chains. No mitoses were present. These cells disappeared at a shorter distance from the wound in the superficial than in the central layers. In the immediate vicinity of the wound were several polynuclear leucocytes. The ends of Descemet's membrane were bent forward and did not reach the wound. Its endothelial layer was interrupted before it reached the ends, but showed no other changes.

Experiment 6.—Weight of rabbit 1400*g*. Wound, 5*mm* long; eight hours old.

The wound was a glistening gray depression. Its margins gaped outward. The surrounding cornea was clear.

Microscopically the wound was a broad fissure empty in the middle. A fine mesh of fibrin occupied the posterior part to a slight depth. Anteriorly it was filled with epithelium from each side of the wound which formed a wedge with its point down-

ward. The epithelium was thinner at the margin of the wound than elsewhere on the cornea. Mitoses were present in the epithelium in the wound, on its margins, and over the entire corneal surface, in some slides as many as 25. The most frequent forms were equatorial plates and amphiasters. They were chiefly in the lower layer, but occasionally one could be found in the middle layer.

Near the wound in the cornea propria were swollen, badly stained spindle-shaped cells without nuclei. Farther from the wound these cells sometimes contained nuclei and even mitoses. The ends of Descemet's membrane were slightly bent forward. There were no changes in the endothelium.

Experiment 7.—Weight of rabbit, 1300*g*. Wound, 4*mm* long; ten hours old.

Clinical appearance the same as in the preceding.

Microscopically the wound was a narrow fissure filled with epithelium to its posterior extremity, where it was covered with a layer of fibrin. The epithelium which had come from the one side had not blended with that from the other, but was separated from it by a narrow space. The epithelium showed no deformation. In other specimens the upper flat cells of the epithelium in the wound came into contact. There were no changes in the epithelium on the surface of the cornea. Mitoses occurred both in the wound and on the corneal surface, chiefly close to the wound margin, in numbers from 10 to 16. There were no special changes in the cornea propria near the wound, but farther away were spindle-shaped cells with nuclei undergoing segmentation (mitoses). The ends of Descemet's membrane were far from the wound and bent somewhat forward. There were no changes in the endothelium.

Experiment 8.—Weight of rabbit, 1250*g*. Wound, 6*mm* long; twenty-four hours old.

The wound looked like a gray stripe with a lustrous surface. The surrounding cornea was clear.

Microscopically the wound was shaped like a trapezium with its broader base to the anterior chamber, from which it was separated by a layer of fibrin which joined the ends of Descemet's membrane. This layer did not enter the wound but was separated from it by a fairly thick, winding boundary line. No fibrin was present in the wound itself. Anteriorly the epithelium passed like a bridge from one side to the other with-

out entering, and contained a few karyokinetic figures near the margins.

There were no marked changes in the cornea propria. Near the wound were some spindle-shaped cells without nuclei and badly stained. No mitoses were to be seen. The ends of Descemet's membrane were bent forward. There were no changes in the endothelium.

These observations on the process of regeneration of the epithelium may be thus summarized.

An hour after the operation the epithelium near the wound grows gradually thinner and appears to be cut off obliquely, while the lower layer of cells become lower, broader, and change from cylindrical to cuboidal. Close to the wound it consists of a single layer of flat cells which often does not reach the margin. It is not easy to tell the cause of this deformation, but it is certainly not due to the form of incision. It is present constantly and seems to me to controvert Ranvier's theory, for if the epithelial cells were pressed together on the surface of the cornea they would be obliged to fall into the wound at once.

The epithelium on each side of the wound begins to advance and, after reaching the margin, to sink into the wound to a depth determined by the position of the fibrinous plug. The form of the wound on section is that of a more or less narrow fissure, wider anteriorly and still wider posteriorly, as if made from two funnels, the smaller in front, the larger behind. This form is due to the elasticity of the two limiting membranes which draw apart the outermost layers of the cornea propria. In some cases fibrin fills the entire space and even protrudes from it, in others it fills only the posterior funnel, rarely it is not present, except to separate the unfilled wound from the anterior chamber. Dependent on the condition of the fibrin the epithelium sometimes arches over the wound from one margin to the other without sinking into it, sometimes it fills the anterior funnel, and rarely it fills the entire wound to the posterior opening. It retains its normal structure and the usual three layers of cells can be plainly distinguished. I have no doubt that the multiplication of cells, which manifests itself in the

presence of karyokinetic figures, is a factor in causing the epithelium to sink into the wound. This multiplication begins immediately after the infliction of the wound, reaches its maximum in three or four hours, remains the same for three or four hours longer, and then gradually retrogresses, but has not completely disappeared at the end of twenty-four hours. At first the mitoses lie at some distance, sometimes very far from the wound. This fact has already attracted attention, and Kanel tried to explain it by the assumption that the cells close to the wound underwent changes which deprived them of a portion of their vitality. I have not been able to discover any order in the arrangement of the mitoses, neither have I been able to observe the so-called zone of regeneration described by Eberth, Leber, and Pfitzner. Proliferation takes place very rapidly close to the wound, and in the course of four hours mitoses are to be met with both on the margins and in the wound itself. The mitoses are principally found in the deep layer of the epithelium, rarely in the middle layer. The cells which thus multiply must exert pressure on the neighboring cells and move them from their positions. The latter naturally yield in the direction of least resistance, toward the wound. The close connection between the sinking of the epithelium into the wound and the karyokinetic process is best shown perhaps by the parallelism between them: after the wound has been filled with epithelium, mitoses are found in small numbers or not at all on the surface of the cornea. I have found no trace of a direct segmentation of the cells and no evidence of an amœboid movement of the epithelial cells toward the wound.

CHAPTER III.—*Regeneration of the corneal substance proper and of the endothelium.*

Several theories have been advanced to explain this regeneration, but they are conflicting.

Experiment 9.—Weight of rabbit, 1150*g*. Wound, 5*mm* long; two days old.

The wound appeared like a gray stripe with lustrous surface.

Close to it the cornea was slightly hazy. There were no signs of irritation.

Microscopically the wound was an oblique fissure wider in front and still wider behind than in the middle. It was about two-thirds filled with epithelium (Fig. 2, E Pf), which formed several shovel-shaped processes separated by empty spaces. The posterior third was occupied by a fine fibrinous mesh (Fig. 2, F Pf) containing no formative elements. Mitoses were present in both the superficial and deep portions of the epithelial plug. On the surface of the cornea the epithelium did not reach the margins of the wound, but left an uncovered space. At no great distance from the wound on each side were accumulations of mitoses in the deep layer of basal cells.

In the cornea propria near the wound was a small number of spindle- and club-shaped cells, in some of which no nuclei could be seen, while in others they looked like faintly colored, finely granular vesicles. Mitoses were present in some cells (Fig. 2, M). There were no leucocytes. The ends of Descemet's membrane bent a little into the wound, and on their convex surfaces were collections of intensively stained spindle-shaped cells. There were no changes in the endothelium.

Experiment 10.—Weight of rabbit 1550*g*. Wound, 6*mm* long; three days old.

The wound was very deep, gray, with gaping margins. Its surface was lustrous and the surrounding cornea transparent.

The form of the wound under the microscope was that of a trapezium with its broader base forward. The epithelium sank into it in a thick layer from each side and filled its entire posterior portion (Fig. 3, E Pf). Anteriorly it presented a crater-like depression, the walls of which were covered with epithelium. Posteriorly it was separated from the anterior chamber by a thick layer of fibrin (Fig. 3, F Pf). Some of the epithelial cells in the wound did not stain well and looked like bright vesicles with dark margins. They were larger than the normal cells (Fig. 3, T). In the superficial layers such cells appeared to be compressed and assumed oval forms. In places several were merged into a large globular or ellipsoidal cavity in which usually no nuclei could be seen, but sometimes shrunken, flattened nuclei were present on the periphery of the cavity and produced the characteristic "seal-ring" (Fig. 3, S). In one place the epithelial cells had formed a clavate mass with

several cells on its periphery, which resembled a "pearl" (Fig. 3, P). No mitoses were present in the epithelium in the wound, but they were on the surface of the cornea, both at the margins of the wound and at a distance from them (Fig. 3, M). No leucocytes were found in the wound.

On each side of and near the wound in the cornea propria was a considerable number of spindle-shaped cells of different sizes, most of which contained badly stained, vesicular, finely granular nuclei. In a few cells were karyokinetic figures (Fig. 3, M). The corneal corpuscles were swollen and some, at a considerable distance from the wound, contained mitoses. No leucocytes were present.

There were no changes in the endothelium. The ends of Descemet's membrane were bent a little forward and on them were collections of cells as in Experiment 9. In the sections of another eye occasional elongated spindle-shaped cells lay on the posterior margin between the ends of Descemet's membrane.

Experiment 11.—Weight of rabbit 1600*g*. Wound, 4*mm* long; four days old.

The wound looked like a glistening gray stripe. The surrounding cornea was transparent.

Under the microscope the wound was seen to be wider in front, and yet wider behind, than in the middle. The anterior portion was empty, and over it passed the epithelium like a bridge from one side to the other. The epithelium was about twice as thick as normal, of generally normal structure, and presented no unstained cells. There were mitoses on the surface of the cornea, some near the wound, others far from it. The posterior part of the wound was occupied by a fine-fibred mesh of fibrin, while in the central narrow part was a quantity of spindle-shaped cells with vesicular or elongated nuclei which were badly stained by hæmatoxylin and could not readily be distinguished from the cell protoplasm. More highly magnified, they appeared to be formed of a mass of little granules. In some cells the nuclei were intensively stained. Beside the spindle-shaped, there were club-shaped cells in the centre. Mitoses were present in both forms. Neither cells without nuclei nor leucocytes were to be found.

About the wound the cornea propria was about one and a half times as thick as normal, and contained a considerable number of spindle-shaped cells, similar in form to those in the centre,

with badly stained nuclei. In some cells the nuclei were intensively stained, in some there were mitoses. Farther from the wound were similar spindle-shaped cells, some of which also contained mitoses. No leucocytes were present.

There were no changes in the endothelium. Columns of spindle-shaped cells extended along the posterior margin of the wound, penetrating the mesh of fibrin, from each end of Descemet's membrane. For the most part these cells contained no nuclei. Here and there hemispherical cells with large nuclei rested upon them and projected into the anterior chamber. The ends of Descemet's membrane were bent slightly forward, and around each in the cornea propria was a group of spindle-shaped cells which extended backward and contained mitoses.

Experiment 12.—Weight of rabbit 1150*g*. Wound, 5*mm* long; five days old.

The wound was a glistening gray stripe. The cornea was clear.

Microscopic picture (Fig. 4). The wound was broad and filled with a fine-fibred mesh of fibrin, over which the epithelium passed without interruption from one margin to the other. It was much thicker than normal, and was composed of polygonal cells with several layers of flat cells, and contained no mitoses. Over the rest of the cornea the epithelium was unchanged and showed no mitoses. There were cell elements of various forms throughout the cavity of the wound, the majority spindle-shaped, others clavate, pyriform, irregularly polygonal, etc. Some were solitary, some joined together. All these cells contained nuclei, some elongated, some vesicular, and they often contained mitoses (Fig. 4, M).

The cornea propria near the wound was thickened and contained the same sorts of cells as those in the wound as well as mitoses (Fig. 4, M). There were no leucocytes. Between the ends of Descemet's membrane, along the posterior margin of the wound, stretched columns of elongated spindle-shaped cells in which mitoses were to be seen here and there. In other respects the picture was the same as the preceding.

Experiment 13.—Weight of rabbit 1700*g*. Wound, 4*mm* long; six days old.

Wound a glistening gray stripe. Surrounding cornea clear.

Microscopically the anterior third of the rather broad wound was filled with cellular tissue which blended on each side with the true corneal tissue, so that it could be distinguished only by

the fact that the newly formed tissue was more intensively stained. The epithelium over it was twice as thick as usual, and the upper layer of flat cells was in places stained badly or not at all. It contained no mitoses. The rest of the wound was filled with a fine-fibred mesh of fibrin intersected by thick, heavily stained little bundles of fibres. In the fibrin were collections of spindle- and club-shaped cells, some close to the centre, the others near the cut lamellæ of the true corneal tissue, so as to give the impression that cells projected from between the connective-tissue spaces. Some cells contained mitoses. No leucocytes were present.

The ends of Descemet's membrane were bent somewhat forward and joined together by a long column of elongated, spindle-shaped cells. In other slides from the same specimen the spindle-shaped cells did not form an unbroken row, but were strewed about without order. Karyokinetic figures were present. The adjacent cornea propria was swollen, but to a less degree than in wounds five days old, and it was permeated by the same sort of cells as those in the wound. There were no changes in the endothelium. Only on the ends of Descemet's membrane, toward the anterior chamber, were collections of cells which represented to a certain degree the ends of the above-mentioned columns of cells.

In specimens from another eye, where the length of the wound was less, the whole cavity was filled with cicatricial tissue.

Experiment 14.—Weight of rabbit 1450*g*. Wound, *6mm* long; seven days old.

Wound a glistening gray stripe. Surrounding cornea clear.

Its anterior portion was filled with young granulation tissue, sharply distinguishable by its staining. Very few fibres were to be seen. Near the cut lamellæ the granulation tissue was not so rich in cells, but was composed chiefly of fibres which blended with the normal tissue. The epithelium, which dipped into the wound like a funnel, was three times as thick as normal and contained clear, unstained, round or elongated cells without nuclei in both the deep and superficial layers.

The posterior part of the wound was filled with fibrin with granulation elements present only near the cut lamellæ. Along the posterior margin of the wound, between the ends of Descemet's membrane, were columns of elongated cells upon which, on the side toward the anterior chamber, rested hemispherical cells

rich in plasma. Here and there in the latter were mitoses. In the corneal epithelium from two to five mitoses could be seen. There were no leucocytes, and other conditions were as before.

Experiment 15.—Weight of rabbit 1250*g*. Wound, 5*mm* long; eight days old.

Clinical appearance the same as before.

The anterior part of the wound was filled with young granulation tissue, the posterior with fibrin which contained isolated spindle-shaped cells. Along the posterior margin of the wound, between the ends of Descemet's membrane, lay columns of elongated spindle-shaped cells. The epithelium over the wound was of normal thickness. In other respects the conditions were as in the preceding.

Experiment 16.—Weight of rabbit 1400*g*. Wound, 4*mm* long; nine days old.

Clinical experience the same as before.

The wound was filled with cicatricial fibrous tissue distinguishable by the intensity of its staining. In the central part was an elongated islet of epithelial cells separated from the rest of the epithelium by a broad band of cicatricial tissue which blended on each side with the normal cornea. There were no leucocytes. The epithelium over the wound was twice as thick as usual, its superficial layers very badly stained. The ends of Descemet's membrane were somewhat bent forward and united by a little bundle of fibrous tissue covered by endothelium on the side toward the anterior chamber.

Experiment 17.—Weight of rabbit 1300*g*. Wound, 5*mm* long; ten days old. Clinical appearance the same as before.

The wound was filled with intensively stained fibrous cicatricial tissue with interstitial layers of fibrin of considerable thickness. In the anterior part its fibres interlaced irregularly and formed a felt-like structure; in the posterior part they lay in regular little bundles which spread out in a fan-like form from one end of Descemet's membrane. The other end of the latter was withdrawn far from the wound, while the cornea propria between it and the cicatrix, as well as the latter, was covered with endothelium. The epithelium over the wound was considerably thicker than usual and contained no mitoses, though in some sections a few of the latter were found some distance away.

Experiment 18.—Weight of rabbit 1200*g*. Wound, 5*mm* long; two weeks old. Clinical appearance as before.

The cicatricial tissue which filled the wound was intensively stained. The fibres were very wavy and in places formed a felt-like mesh. Between the bundles of fibres were scattered a considerable number of nuclei. There were no leucocytes. The epithelium over the scar was three times as thick as usual, retained its normal structure, and presented here and there a karyokinetic figure. A few of the latter were also present on the surface of the cornea. The ends of Descemet's membrane were bent forward and united by a thick little bundle of fibrous tissue attached to their convex surfaces.

The results of these experiments are instructive in many ways. The clinical pictures are remarkable and prove that central, uncomplicated wounds of the cornea heal without reactive inflammation—at least in rabbits, as no irritation, vascularity, or cloudiness of the cornea was observed. This fact, which is so at variance with usual clinical observations, is confirmed and explained by the microscopic examination, which demonstrated the absence of leucocytes at every stage.

So far as it is explained by these experiments, the regeneration of the *substantia propria* is as follows: Three or four hours after the infliction of the wound, badly stained, spindle-shaped cells, with well stained, thin, linear nuclei, appear in its immediate neighborhood, together with a gathering of round and elongated nuclei, two, three, four, or more in a row, in the compressed corneal corpuscles, forming a picture which reminds one of the earliest stage of interstitial keratitis. At some distance away appear a small number of karyokinetic figures.

But I must say that the importance and the origin of these nuclei and mitoses are not clear to me. Ballowitz, in his investigations, did not once observe mitoses, and therefore adopted Hansemann's theory, that the physiological regeneration comes through mitotic division only in the cells which directly suffer an external, mechanical, thermic, or chemical irritation, and that the physiological cell division is the result of a direct, mechanical wearing away of the tissue. But I saw on the second day spindle- and club-shaped cells with large, finely granular, vesicular nuclei close to the

wound, and saw mitoses also, which gradually increased in number. On the fourth day there were many spindle-shaped cells in the wound, and they continued to increase, both in the wound and in its immediate vicinity, until it became filled with granulation tissue, which later changed to cicatricial tissue.

We have here a clear case of regeneration of connective tissue from its own elements. The fibrin forms a temporary plug to close the wound, and then a support for the wandering cells and histogenic elements that later appear. It takes no active part in the regeneration, but gradually disappears with the development of granulation tissue, probably from absorption. Nothing could be seen of its change into "synaptic fibres," described by Ranvier, to draw the margins of the wound together.

Regarding the epithelial plug, signs of progression prevail during the first two days, especially in those cases in which the epithelium sinks deeply into the wound and a large quantity of cells is needed. With the development of connective tissue in the scar, the epithelium is pressed out of the wound and some of the superabundant cells die away both on and below the surface. A sort of vacuolization takes place in the cells, so that they appear as bright rings or ovals, with dark borders, while the nuclei shrink away until they disappear. Sometimes several of these cells merge into a large round or oval space. Occasionally one of these spaces presents on its periphery shrunken nuclei, the typical "seal-ring." Sometimes the lower part of the epithelium plug is cut off by and is isolated in the midst of the growing connective tissue, but eventually these cells atrophy and disappear.

The regeneration of the endothelium takes the following course, so far as has been determined. Formless accumulations of cells without nuclei appear after two days on the bent ends of Descemet's membrane where the endothelium ceases. They are intensively stained with hæmatoxylin. One day later elongated spindle-shaped cells extend along the posterior margin from one of these to the other. These elongated cells are at first separate, but their number gradu-

ally increases, they arrange themselves in columns, several in a row, and finally form a cord across the wound uniting the ends of Descemet's membrame. In addition to these elongated cells others are found, shorter, larger, sometimes hemispherical. Their nuclei are clearly to be seen, mitoses are often present, and they lie on the spindle-shaped cells projecting into the anterior chamber.

I cannot agree with Marchand that all cells found in the posterior part of the wound on the fourth day are of endothelial origin. The evidence he adduces in favor of this is not sufficient. He says that fusion with proliferating corneal cells is excluded because no increase has been shown, and the space in which the proliferating endothelial cells lie is plainly separated from the cut cornea. I have already mentioned that mitoses are present in the cornea propria near the wound on the second day, at the time when only formless accumulations of cells are to be found on the ends of Descemet's membrane, and I think this fact suffices to controvert Marchand's idea.

I cannot say what part is taken by the endothelium in the formation of the cicatricial tissue, but I conjecture that it originates the little bundles of connective-tissue fibres which join the cut ends of Descemet's membrane. In wounds eight or nine days old these little bundles are covered on the side toward the anterior wall of the chamber by an uninterrupted layer of flat cells which blend with the neighboring endothelium.

CHAPTER IV.—*Restoration of Descemet's membrane. A new theory regarding the formation of the same.*

Experiment 19.—Scar thirty days old.

The entire region of the scar was somewhat contracted. The epithelium was in general of normal structure, but about twice as thick as usual. The basal cells were much distended, their elongated nuclei were in their usual positions. The middle layer of polygonal cells was very thick, yet the cells showed no change. Mitoses were present in the basal cells near the scar and rarely elsewhere on the surface of the cornea. Bowman's membrane was absent. The site of the wound in the cornea propria could

be easily recognized by the more wavy and irregular course of the fibres and the quantity of nuclei, which was greater in the posterior than in the anterior part of the scar. The cut ends of Descemet's membrane were withdrawn some distance, one was bent forward and lay in the corneal tissue, the lamellæ of which bent backward about it. The two ends were united by a bundle of newly formed fibrous tissue which could be distinguished from the normal corneal tissue by the radiation of its fibres from the posterior surface of Descemet's membrane, by the looseness of its texture, and by the quantity of nuclei. The nuclei at the posterior margin of the wound were elongated and linear, those near the middle globular and oval. There was nothing abnormal to be seen in the endothelium. It was separated from the cicatrical tissue by a very thin, homogeneous membrane of even thickness, which met Descemet's membrane on each side at a very acute angle and blended with its tissue.

Experiment 20.—Scar forty-five days old.

The general appearance was the same as in the preceding. Mitoses were present (Fig. 5, M) only in the deep layer of the epithelium in and about the scar. One end of Descemet's membrane bent forward rather more than the other. The newly formed, very thin, homogeneous membrane of even thickness (Fig. 5, D) formed an acute angle with the convex side of each.

Experiment 21.—Scar sixty days old.

The general microscopic appearance was the same. No mitoses were to be found in the epithelium. The newly formed Descemet's membrane was rather thicker and joined the ends of the old membrane in the same way as in the preceding case.

Experiments 22 and 23.—Scars 90 and 105 days old.

General appearance the same. The scar (Fig. 6, N) was very broad. The number of nuclei in the cicatricial tissue at the posterior margin had notably diminished. The fibres were less wavy and the boundary line between the cicatricial and normal tissue was not as well marked as in the preceding cases. The newly formed Descemet's membrane (Fig. 6, D) was about half as thick as the old one and held the same relations to its ends as before. In another specimen, in which the ends of the old membrane (Fig. 6, DD) were not bent forward, the new membrane was a direct continuation of them. Through the cicatricial tissue near its posterior margin ran little bundles of fibres which united different places of the arching new membrane and blended with its

tissue. Almost no nuclei were to be seen here. This new membrane was stained black by Weigert's method, the same as the old. Where it lay directly on the scar tissue a well-marked fibrousness was present. There were no mitoses in the epithelium.

Experiment 24.—Scar 120 days old.

General appearance the same. The new Descemet's membrane (Fig. 7, D) was only rather thinner than the old. Its close connection with the neighboring fibrous tissue was evident. Almost no nuclei were to be seen in its immediate neighborhood. There were no mitoses in the epithelium.

From these microscopical examinations we can conclude that the completion of a scar takes a long time and that the process differs in the different layers of the cornea. The active increase of cells in the epithelium lasts several weeks and results in a considerable thickening of the epithelial layer. In the true corneal tissue a shrinking and a disappearance of nuclei constantly take place, especially at the posterior margin of the scar: the fibres become less wavy and approach the normal, while the sharp boundary line between the cicatricial and normal tissue gradually disappears. The cicatricial tissue, which at first is of a very loose texture, becomes compact and contracts more and more, with the inevitable result of a disturbance of the curvature of the cornea, partially compensated for by the changes in the epithelium.

Most important of all is the formation of a new Descemet's membrane. The first trace of this is to be seen four weeks after the infliction of the wound, when it appears as an extremely thin, glistening, homogeneous layer separating the endothelium from the cicatricial tissue. It increases in thickness very slowly. At the end of two months it is still very thin. In from three to three and a half months it is about half as thick as the normal; after four months it is of nearly normal thickness. Its thickness is probably the same everywhere in all cases. Its relations to the ends of the old membrane vary as the ends of the latter are more or less bent forward. In the rare cases in which these ends are bent forward slightly or not at all, it appears to be

directly continuous with them, and the dividing line can be recognised only by the difference in their thickness, or by a prominence on the ends. But when the ends are more bent forward, sometimes they form a sort of curl, the new membrane is attached to the posterior convex surface, with which it forms a more or less acute angle, and a dark border line can be seen between them. Both membranes are stained black by Weigert's resorcin-fuchsin mixture. Very often it can be clearly seen that when it lies directly on the cicatricial tissue its fibres blend with those of the latter.

How is the new Descemet's membrane formed? All authors have hitherto agreed that both the new and the old membranes are excretory products of the endothelial cells, cuticular formations. But I am convinced:

1. That this theory is based on insufficient grounds and is only a repetition of the old fable of the cuticula.

2. That it is not supported anatomically or embryologically.

3. That nothing can count upon general acceptation unless it can furnish satisfactory answers to many dependent questions.

4. That this conclusion cannot be proved with our present knowledge.

If we examine the evidence brought forward by Ranvier, Wagenmann, and others, and the deductions drawn therefrom, we find nothing proven, nothing explained, and if we admit the possibility that this membrane was secreted by the endothelium, we are confronted with such questions as these, very difficult or impossible to answer.

If the endothelium on the posterior surface of the cornea secretes cuticula, why does not the endothelium on other serous membranes do likewise, as there is no morphological or genetic difference between them that we know of? Why does Descemet's membrane appear so late in comparison with the endothelium, both embryologically and pathologically? Why does not the endothelium secrete this membrane when its cells are succulent and rich in nutritive material, instead of after they have become changed into thin little plates? How is the idea of a structureless

cuticula to be reconciled with the lamellar and fibrous structure of Descemet's membrane?

Satisfactory answers can be given to all these questions, if we abandon the old theory of its cuticular formation and assume that Descemet's membrane represents the limiting lamella of the cornea, which has undergone hyalinization (in optical properties, not in chemical composition), as the result of constant contact with the aqueous, a process which must be considered purely physiological. The influence of the aqueous on the connective tissue, which it reaches through the stomata between the endothelial cells, can naturally be manifested only after the lapse of some time, and this explains why Descemet's membrane is formed after all the other layers of the cornea in both embryological and pathological conditions. If this is correct, it is evident that no hyaloid substance would be formed beneath the endothelium of the pleura and other serous membranes, which have no aqueous in contact with them.

Conclusions.

1. After perforating incised wounds of the cornea, regeneration does not take place simultaneously in all parts, but the epithelium is first restored, then the true corneal tissue, and finally Descemet's membrane.

2. The epithelium is regenerated through an active proliferation, as shown by the presence in it of segmentation figures over the whole surface of the cornea.

3. This proliferation begins immediately after the receipt of the injury, reaches its maximum in three or four hours, then gradually decreases and disappears about the end of the first day.

4. Mitoses appear first on the surface of the cornea at a considerable distance from the wound, but after three hours they are to be found in its immediate vicinity.

5. After four hours, mitoses appear in the epithelium, which has sunk into the wound.

6. There is no evidence of an amœboid movement of the epithelium toward the wound, or of a direct division of the epithelial cells.

7. Ranvier's theory is untenable, the evidence he adduces is weak.

8. After the regeneration of the true corneal tissue, the epithelium is gradually pressed forward out of the wound, and the superfluous portion dies away.

9. This necrosis takes place both on and beneath the surface of the epithelium, and involves both single cells and entire groups. The process by means of which this is accomplished remains unexplained.

10. In most cases the epithelium in the region of the scar remains considerably thicker than normal, because of an increased number of rows of the middle polyhedric cells and a considerable elongation of the basal cells.

11. This thickening of the epithelium is doubtless useful in compensating partially even, if not entirely, for the disturbance of the corneal curvature, which results unavoidably from the cicatricial contraction.

12. The healing of aseptic, uncomplicated central wounds of the cornea takes place, at least in rabbits, with no inflammatory symptoms, no cloudiness of the cornea, vascularity, or signs of irritation.

13. The cornea propria is regenerated wholly through active multiplication of its own elements. In all probability leucocytes take no part therein.

14. Mitoses first appear in the cornea propria four to six hours after the operation, at a considerable distance from the wound; but the importance of this fact is uncertain, because of their inconstancy and small numbers.

15. Cells undergoing indirect segmentation in the cornea propria are to be seen immediately about the wound after two days.

16. Granulation elements appear in the wound after the lapse of three days, and multiply rapidly by mitotic segmentation.

17. The anterior portion of the wound becomes completely filled with granulation tissue at a time when the posterior portion is still occupied by fibrin.

18. The fibrin which fills the wound participates only passively, not actively, in the process of healing.

19. The regeneration of the endothelium occurs simultaneously with that of the true corneal tissue, wholly through mitotic segmentation.

20. Descemet's membrane is completely restored after a perforating wound of the cornea. This restoration takes place at a period considerably later than that of the other layers.

21. Its first appearance in rabbits is in the fourth week, and it attains an almost normal thickness after four months.

22. The new Descemet's membrane cannot be distinguished from the old, either by its appearance or by its standing.

23. The cuticular theory of the formation of Descemet's membrane is an arbitrary assumption which does not accord with its anatomy or embryology, in favor of which no one has adduced convincing evidence.

24. Descemet's membrane is produced by the physiological hyalinization of the limiting lamella of the true corneal tissue, probably through the influence of the aqueous. This theory accords with the anatomy and embryology of the membrane, as well as with the observations made of its formation in pathological conditions.

Explanation of the Plates.

Fig. 1.—Wound four hours old (Leitz, oc. 3, ob. 7 for all the plates). E, epithelium. E Pf, epithelial plug. F Pf, fibrin plug. M, mitoses. L, leucocytes. DD, cut ends of Descemet's membrane.

Fig. 2.—Wound two days old. E, epithelium. E Pf, epithelial plug. F Pf, fibrin plug. M, mitoses in epithelium. M_1, mitoses in the fixed corneal cells. DD, ends of Descemet's membrane.

Fig. 3.—Wound three days old. E, epithelium. E Pf, epithelial plug. F Pf, fibrin plug. M M_1, mitoses. T, degenerated cells. P, pearl. S, seal-ring figure.

Fig. 4.—Wound five days old. E, epithelium. E Pf, epithelial plug. F Pf, fibrin plug. M M_1, mitoses. DD, ends of Descemet's membrane.

Fig. 5.—Scar forty-five days old. E, epithelium. M, mitoses.

N, scar. DD, ends of the old Descemet's membrane. D_1, new Descemet's membrane.

Fig. 6.—Scar ninety days old. E, epithelium. N, scar. DD, ends of old Descemet's membrane. D_1, newly formed Descemet's membrane.

Fig. 7.—Scar 120 days old. Preparation stained with Weigert's resorcin-fuchsin-ferric-chloride mixture. E, epithelium. N, scar. DD, ends of the old Descemet's membrane. D_1, newly formed Descemet's membrane.

REPORT OF A CASE OF FLAT SARCOMA (ENDOTHELIOMA) OF THE CHOROID—DEATH ONE AND ONE-HALF YEARS LATER FROM GENERAL METASTASES.

By Dr. ARNOLD KNAPP.

(*With three figures on Text-Plates II. and III.*)

[FROM THE LABORATORY OF THE NEW YORK OPHTHALMIC AND AURAL INSTITUTE.]

S. G., female, twenty-eight years old, was first seen on March 30, 1903, when she complained that the left eye had been inflamed for two months, with diminution of sight. On oblique illumination with dilated pupil, a brown swelling could be distinctly seen behind the iris on the temporal side. Diagnosis of sarcoma of the choroid was made and enucleation advised.

The patient refused and was not seen again until October 10, 1903, when the left eye was in a condition of acute glaucoma, with hazy cornea, dilated pupil, distended inferior scleral veins, and increased tension.

On October 24th the eye was enucleated without incident. During her stay in the hospital the patient complained somewhat of pain in the region of the liver, but physical examination revealed no abnormality.

On July 26, 1904, she was admitted to the City Hospital, Blackwell's Island, in the service of Drs. E. Evans and Theodore Janeway. Dr. L. W. Pollok, the House Physician, has very kindly furnished me with the following data.

Previous History: After her stay in the Eye Hospital, the patient was operated upon three months ago at the Mt. Sinai Hospital, where an ovarian cyst was removed. Subsequently she was treated in the Beth Israel Hospital for what she called

ILLUSTRATING DR. ARNOLD KNAPP'S CASE OF FLAT SARCOMA OF THE CHOROID.

FIG. 1.—Showing diffuse infiltration of the uvea, with central area of necrosis and epibulbar nodule.

ILLUSTRATING DR. ARNOLD KNAPP'S CASE OF FLAT SARCOMA OF THE CHOROID.

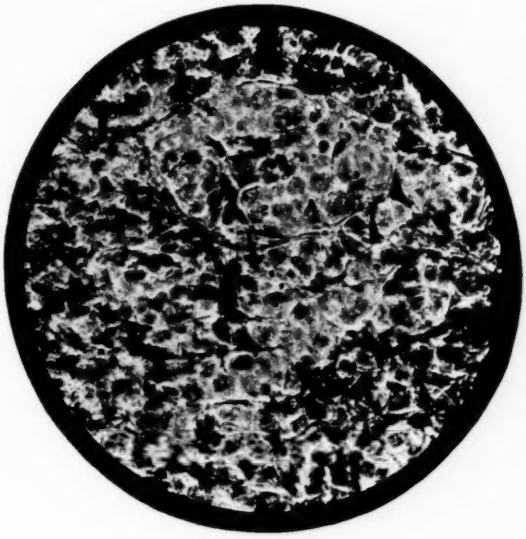

FIG. 2.

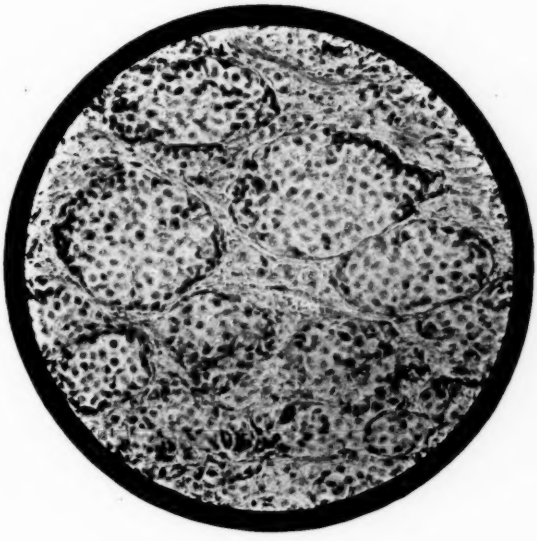

FIG. 3.

FIG. 2.—Microphotograph of choroidal tumor near optic nerve, showing endothelial type of cells.

FIG. 3.—Microphotograph of metastatic tumor of the skin.

"a cold on her chest." The only thing she particularly complained of was that she had been losing weight for two years.

On admission the patient is extremely weak and is brought in on a stretcher. She is emaciated; not jaundiced; thoracic breathing. There is a false point of motion at the junction of the manubrium and the gladiolus of the sternum with marked overriding of the lower fragment, so that below this there is distinct bulging with depression on either side. There is a false point of motion with crepitation in the 7th, 8th, and 9th ribs in the right mid-axillary line. She complains of pain in the legs, which are flexed. There is a linear cicatrix over the symphysis. On the surface of the chest and of the abdomen there are many non-pigmented nodules under the skin, freely movable on the underlying tissue and not adherent to the skin; they vary from the size of a split-pea to that of a corn-kernel.

Lungs: Infraclavicular fossæ retracted, tympanitic percussion note with broncho-vesicular breathing. Dulness begins at the 3d interspace on the right side and is continuous with the liver and heart dulness. Posteriorly, dulness in both supraspinous fossæ, on the left side more than on the right, and below the scapula on each side; crepitant and subcrepitant râles. In the left supraspinous fossa breathing is bronchial.

Liver: Dulness begins at 3d interspace continuous with the area above described, and extends to the costal margin. The edge is palpable. In the middle line the edge can be felt *6cm* below the xiphoid cartilage.

Spleen: Not enlarged.

Abdomen: Distended and tympanitic. No evidence of any tumor.

Upper Extremities: Normal.

Lower Extremities: Œdema of the feet. Pain experienced in hips on flexing knees. No knee-jerk, no clonus, no Babinski. Muscles atrophied.

Repeated blood examinations showed the usual changes associated with secondary anæmia. Urine negative.

On September 6, 1904, a spontaneous fracture of the left humerus occurred *6cm* below the head.

On September 7th there was a subtrochanteric fracture of the right femur.

Several nodules were removed from the skin for examination.

Without any appreciable change in her condition, the patient

slowly failed and died, September 20th, from inanition. A few days before her death there was some rise of temperature. There had never been any cough. An autopsy was not permitted.

Examination of the Eye: The eyeball presents a round nodule on the nasal side of the optic nerve. After hardening in formalin, an antero-posterior section is made through the eyeball, passing through the nodule.

Macroscopic Condition: (See Fig. 1 on Plate II.). The nodule is situated posteriorly on the sclera near the optic nerve, with a broad base measuring 8*mm* in diameter. It has a white capsule. The interior is gray with a yellow centre. It can be seen to involve the outer layers of the sclera which at one point are very thin. The vitreous is partly unchanged, diminished in quantity, drawn in a radiating manner to the ciliary processes from the papilla. Near the ciliary processes there are a few fresh hemorrhages. In the nasal half of the fundus the retina is irregularly elevated and thickened with connective-tissue changes. It is adherent in folds to the under-lying tissue which is mottled in places. On cross-section between the retina and the sclera in this half of the eyeball new-formed tissue is present which appears thickest in the ciliary region and near the optic nerve. The thickening in the ciliary body is white, while the posterior swelling is pigmented.

Microscopic Examination: In the anterior part of the eye the iris angle is obliterated owing to a broad adhesion of the iris to the cornea, with retraction of the ciliary body and of the root of the iris. At the pupillary margin ectropion of the uvea is pronounced.

The new-formed tissue observed with the naked eye between the retina and the sclera, extending from the optic nerve to the ciliary body, proves to be a tumor which can be divided into three parts to facilitate description of the microscopic condition: (1) the ciliary portion; (2) the part near the optic nerve; (3) the intervening part, which is very much less thickened.

The ciliary portion measures 1½*mm* in thickness; the region of the ciliary body is diffusely infiltrated with new cells, which cease abruptly at the root of the ciliary processes. These cells, especially in the parts next to the sclera, are arranged in the clefts and splits in the tissue, and are large and round, with large and deeply-stained nuclei, on the whole resembling epithelioid cells. In the more compact parts of this infiltration, viz. in the

part near the ciliary processes, the cells are small, irregularly crowded together, and often fusiform. There is a striking absence of blood-vessels. Coarse, granular pigment is scattered throughout this region, especially along the scleral border. Proceeding backwards, the cells are again not so crowded together and consequently are much larger. The sclera at this point is distinctly involved.

At the other extremity of the tumor, the part near the optic nerve shows a prominence of 1⅓*mm.* It is sharply defined by the retina and the sclera and presents in a beautiful manner the characteristics of this tumor. The cells are all large with large, deeply stained nuclei. They are generally arranged in alveoli or between thin intervening septa, or in the form of distinctly enlarged lymph spaces which are filled with these cells (see Fig. 2). The scarcity of blood-vessels is noticeable. The pigmentation is finely granular, varying in quantity in the different sections, is irregular in distribution, and frequently accompanies the connective-tissue septa. In the overlying retina the layer of rods and cones is obliterated, the pigment epithelium is hypertrophied, some of the cells are distended and without pigment, and with intervening round, homogeneous bodies. The cellular elements in the nuclear layers are increased. This feature becomes more marked at the papilla. The nerve is somewhat inflamed, the markings are not distinct. The papilla is swollen and the lamina cribrosa is pushed backward.

The intervening part of the tumor, situated at the equator of the eyeball and where the swelling is the least pronounced, shows no evidences of choroidal stroma or of tumor structure. The region is occupied by a more or less homogeneous, poorly stained area with irregular pigmentation, unquestionably in a condition of necrosis. The superposed retina is very much changed. The signs of an old chorio-retinitis are well marked. The retina and the underlying tissue are firmly grown together; the retina has lost its histological structure. The pigment epithelium presents irregular proliferations and in places is absent. There are small circumscribed hemorrhages. The area of necrosis extends posteriorly well into the substance of the sclera. At the junction of this area with the more prominent part of the tumor near the disc there is situated on the posterior surface of the sclera the nodule previously mentioned. This nodule consists at its base of an infiltration of the layers of the sclera, giving it a fusi-

form shape as it is traversed by septa of the sclera. The entire nodule is extremely cellular. The cells resemble those found in the intraocular portion of the tumor, except that they are not so large, and are frequently more spindle-like in type, and there is less pigment.

Dr. H. Oertel, Pathologist to the City Hospital, has kindly given me some sections of one of the nodules of the skin which show the following microscopic condition:

Examination of a Nodule from the Skin (see Fig. 3).—In addition to a diffuse infiltration, there are very striking collections of cells arranged in clusters or alveoli without pigment. The cells are typically endotheliomatous and resemble those in the tumor of the eye.

Remarks.—In the eye we find a tumor which has diffusely infiltrated the choroid and ciliary body in one-half of the eyeball, attaining a maximum thickness of $1\frac{1}{3}$*mm*, with the microscopic characteristics of an endothelioma. It agrees in most features with the descriptions of the very rare so-called flat sarcomas of which Parsons, in a recent article,[1] has been able to collect only thirty-one cases. The involvement of the suprachoroidea and adjoining layers of sclera is distinct in this case, and confirms Parsons's supposition that the peculiar topography of these flat tumors is due to the origin and extension of the tumor occurring in the lymph spaces of the suprachoroidea, rather than in the stroma proper as in the usual circumscribed form of choroidal sarcoma. The infiltration of the sclera at one point was so complete as to lead to perforation and the formation of an epibulbar nodule of similar histological structure. A very striking feature of this tumor was the extreme deficiency in blood-vessels, which is also unlike the usual sarcoma, and may explain the necrosis so frequently observed in this form of tumor. The retina was not detached and was generally adherent with inflammatory changes.

The central part of the tumor—*i. e.*, the part situated at the equator of the eyeball, presents the evidences of necrosis, which in this case is also of clinical interest, as the

[1] Parsons, "Diffuse Sarcoma of the Uveal Tract," these ARCHIVES, xxxiii., p. 101, 1904.

necrosed area represents the part which could be seen as a prominent brownish mass behind the iris by oblique illumination at the first examination of the patient. When the eye was opened after enucleation six months later, this region had so diminished in size as to present no unusual prominence.

The glaucoma which is regularly present in these tumors has been supposed to be secondary to interference with the lymph circulation of the eye, but it seems to me that the associated inflammatory changes are not without significance. There was no direct tumor infiltration in the region of the iris angle. A vortex vein passing through the tumor was found normal.

The subsequent course of the case is of great interest, and though incomplete from absence of autopsy, the clinical manifestations of metastases, together with the microscopic examination of one of the skin nodules, furnish certain definite data. Though the topography of this tumor coincides with that of the metastatic tumors of the choroid, this latter possibility need not be considered, to my mind. Metastatic sarcoma of the eye are extremely rare (Wintersteiner [1]). Clinical signs of the primary tumor are generally present; in this case the ocular condition preceded the onset of other manifestations by fully a year.

We have positive evidence of metastases only in the bones (sternum, ribs, humerus, and femur) and in the skin. The liver was apparently not enlarged and there was no jaundice, yet metastases in the liver or in the lungs cannot be absolutely excluded according to Dr. Theodore Janeway, who observed the patient while in the City Hospital.

As is well known, the usual metastases of choroidal sarcoma occur in the liver, brain and meninges, and other organs, in order of frequency. We see, therefore, that the distribution of the metastases of this tumor was also different from the usual choroidal tumors. The infiltration of the lymphatic spaces in the eye by this tumor might suggest probable involvement of the lymphatic glands and of

[1] Wintersteiner, "Tumors of the Choroid," in Schwarz's *Encyclopedia der Augenheilkunde*, p. 21, 1902.

the mediastinum, but of this there was no clinical evidence.

Finally, endothelioma in general are characterized clinically by a slow growth, moderate tendency to the formation of metastases, with tendency to local recurrence. Yet there are (Borst [1]) very rapidly growing, destructive metastases-forming endotheliomata which can be classed among the most malignant tumors. Our case unquestionably belongs to the latter group.

I am indebted to Dr. E. Harlow for the photographs (Figs. 2 and 3).

Explanation of the Figures.

Fig. 1.—Drawing showing the flat nature of the tumor, the diffuse infiltration of the uvea, and the epibulbar nodule.

Fig. 2.—Photograph showing microscopic characters of the ocular growth.

Fig. 3.—Photograph of a section of a metastasic nodule in the skin.

[1] *Die Lehre von den Geschwülsten*, Bergmann, 1902.

MEDULLATED NERVE FIBRES IN THE RETINA.

By Dr. KARL MAYERWEG, Vienna.

(*With Plate VII. of the German Edition.*)

Translated from *Arch. f. Augenheilkunde*, Vol. XLVI., Nov., 1902, by Dr. Matthias Lanckton Foster.

ALTHOUGH medullated nerve fibres of the retina have often been clinically observed, a proportionately small number have been studied microscopically. In one of the following cases a hitherto undescribed accompanying anomaly was present, which seemed to be associated with the development of these fibres.

Virchow was the first to make a microscopical examination of medullated nerve fibres, and to differentiate them from the retinal changes which accompany Bright's disease. He demonstrated the marked varicosities of these fibres, traced the transition into axis-cylinders, and described a dichotomous division of the fine fibres, but did not determine whether the condition was congenital or acquired. Beckmann and von Recklinghausen made similar observations.

The first anatomical confirmation of the ophthalmoscopic picture was made by Schweigger, quickly followed by Schmidt-Rimpler. The layer of medullated fibres presented a fairly triangular form on vertical section through the papilla, and was covered by quite a small layer of transparent nerve fibres. The medullated fibres emerged above the level of the choroidea and showed large varicose swellings. C. H. Usher proved that the fibres of the optic nerve lose their medulla in the posterior part of the lamina

cribrosa and receive their sheaths again at the level of the papilla. He found varicosities attached to the fibres, some spindle-shaped, others round or irregular, and considered them thickenings of the medullary sheaths. Manz examined microscopically three cases which had been studied during life. His results agreed on the whole with those of the preceding authors, but he recognized that the varicosities are swellings not of the sheaths but of the axis-cylinders. He also described another kind of large, globular, apparently hyaline forms, strewed regularly between the optic-nerve fibres, as large varicosities. He did not find divisions of the nerve fibres.

Regarding the number of cases clinically seen, I myself found between October, 1901, and January, 1902, 7 cases among 1727 clinic patients, most of whom were examined with the ophthalmoscope. As all the patients were not thus examined, it may be assumed that its frequency is at least 4 in 1000. Von Hippel found a proportion of 1 in 1000, Manz 1 in 3250, Wollenborg 40 in 6131. As Manz suggests, these discrepancies are probably due to the facts that all the patients were not examined with the ophthalmoscope, and that the condition was not mentioned in the records because lacking in importance. Kölliker found in the records of the Zurich eye clinic from 1872 to 1883 only 58 cases. These were found mostly in one eye; in 13 % in both. They were associated in 13 % with deformitities of the skull, in 48 % with strabismus; 48 % were myopic, 31 % hypermetropic, 20 % emmetropic. The medulated fibres usually ran upward or downward, rarely outward, and never invaded the macula, though often enclosing it.

Case 1.—Woman twenty-two years old, with retino-choroiditis of obscure origin in each eye. Her parents were healthy, she had borne one healthy child, and was in the sixth month of pregnancy.

Ophthalmoscopic Condition.—Right eye: Over the site of the papilla was a yellowish-white spot, irregular, with radiating margins, about three papillary diameters long vertically, by two horizontally. In the midst of this was a small circumscribed patch

of a grayish-red color with indistinct margins. Out from this came a delicate, tortuous, bright fibre to the centre of the vitreous (persistent hyaloid artery). The grayish tissue at the origin of the hyaloid artery was evidently over the entrance of the vessels, which were completely covered by the patch of medullated fibres and first came into view at the margin of the latter. The entire fundus presented spots, partly yellowish gray, partly white, very thickly pigmented.

Left eye: The entrance of the vessels in the papilla could be plainly seen, but they quickly disappeared in a patch of medullated nerve fibres similar to that in the right eye. There was no persistent hyaloid artery.

The fields were contracted for white and for colors. The vision of the right eye was 0.6 with + 1 dioptry; that of the left 0.3.

CASE 2.—My attention was attracted to this case by the great extent of the medullated nerve fibres, and because it seemed to confirm the statements I shall make in conclusion.

The patient was a man twenty-four years old, who had an angioma involving both lids of his left eye, the cheek, and the left upper lip. In the right eye, which was hypermetropic 1 dioptry, medullated nerve fibres spread upward, inward, and outward, in the last direction for a distance of four papillary diameters. The margins of this patch presented the fine radiating striations characteristic of medullated nerve fibres, but the centre was uniformly white. The large vessels were covered in places.

In one of my other cases this condition was associated with optic atrophy, in others with strabismus, myopia with keratoconus, and astigmatism. I did not find in any case medullated fibres at a distance from the papilla, a condition which appears to be quite rare, as it was found by Casper only four times among 14000 persons examined.

Nettleship states that he saw the characteristic white patches disappear in a patient with double choked disc as atrophy appeared. Fossl mentions their disappearance in a case of glaucoma, while Doyne speaks of their existence after neuritis. Wagenmann says that a sector of medullated fibres on the papilla completely disappeared in the course of an optic atrophy due to tabes.

Sydney Stephenson described a patch of medullated nerve fibres situated about five papillary diameters from the papilla, in the left eye of a patient who had 2.50 dioptries of hypermetropia in each eye. De Schweinitz described a very large mass of medullated fibres, which, following the vessels, spread out to the periphery in a highly myopic eye with posterior polar cataract and fine opacities in the vitreous. The papilla was greenish gray and embedded in the medullated fibres. Moll mentions a very extensive patch in a myopic eye, Hilbert one with a coloboma of the uveal tract in which the fibres stretched upward and outward from the papilla in a band $1\frac{1}{2}$ papillary diameters long by $\frac{1}{2}$ broad. Eversbusch pictured a large patch of these fibres in a case of congenital myopia of high degree, and von Hippel found medullated fibres extensively about the papilla in a child two and one-half years old, who had a high degree of myopia in one eye, but no other abnormality in the fundus.

The following cases were studied microscopically:

Case 3.—Left eye. Ophthalmoscopically there were about 5 dioptries of myopia at the papilla, a little more above, rather less below. The upper, inner, and lower margins of the papilla were covered with dense medullated fibres radiating in all directions. Their maximal length downward and inward was from $\frac{1}{2}$ to $\frac{3}{4}$ of a papillary diameter, while fasciculi radiated upward and outward for 5 or 6 diameters.

Macroscopically there was a staphyloma above the optic nerve. The distance from the most prominent point of the staphyloma to the apex of the cornea was 27.8*mm*, while that from the lower margin of the optic nerve to the apex of the cornea was only 24*mm*. The curvilinear distance between the optic nerve and the margin of the cornea was much greater above than below, and the upper part of the globe in the region of the staphyloma was much increased in size. The sclera above the nerve was thin and bluish.

Microscopic Examination.—The eye was hardened, embedded, and cut vertically with a microtome. Most of the sections were stained by the Weigert-Pal method, some by Van Giesen's method, with hæmatoxylin-eosin, and with Weigert's elastic-fibre stain.

In the lower part of the entrance of the optic nerve, the intervaginal space formed a small slit, in the upper part a trapezoidal dilatation. The optic nerve was bent upward in the sclerotic canal. Below, the choroid and retina overtopped the optic nerve like a spur, above, the choroid was retracted from the margin of the nerve so that the sclera, covered sparsely with choroidal rudiments and fibrous tissue, came freely into contact with the contents of the eye. Above, near the optic nerve, the pigment epithelium was sparse and rarefied; below it formed a regular, uninterrupted layer. Thus there was a typical conus formation about the upper margin of the optic nerve. The sclera above the nerve was ectatic and greatly thinned for a considerable extent. The choroid was also thinned. The centre of the papilla was cupped, its margins overlapping slightly on each side.

The medullated nerve fibres formed an extensive layer. All the medullated sheaths ended at about the same level in the posterior lamellæ of the lamina cribrosa, and none could be traced in either the scleral or the choroidal sections of the optic nerve. Here and there in the intrachoroidal portion isolated bundles of fibres regained their medullated sheaths, but soon lost them again. At the margin of the papilla the medullated fibres emerged rather suddenly in the form of a broad zone. Above, wedge-shaped at first, this zone tapered toward the periphery, so that near its end, about the equator of the eye, only a thin layer was to be seen. It then passed over into non-medullated fibres which here and there regained their sheaths for brief intervals. In many places it could be seen that fibres did not become completely non-medullated at once, but continued for some time covered with fine traces of medulla.

At the papilla itself, all the nerve fibres were medullated and the other retinal layers were completely absent, so that these fibres lay upon the pigment epithelium or the lamina vitrea choroideæ, separated only by a very thin, rather crumbly layer of detritus. More peripherally, naked axis-cylinders appeared near the medullated fibres, but nowhere in a compact layer. The medullated fibres themselves formed a very dense plexus in which the majority ran parallel, interlaced by bands of fibres in every direction. They often appeared to be divided. There were many varicosities, some spindle-shaped, some globular, bearing the same relation to the fibres as that described by Manz and others. Near by, very fine medullated fibres provided with

varicosities could frequently be seen to start obliquely, often almost vertically, from the meridional course of the fibres and penetrate the innermost nuclear layer. There were also large, globular, medullated formations of a bright white or yellowish-white color, which lay in the medullated zone as well as outside of it in the neighboring layers of the retina. Many of these had a fine process, stained black. As this medullated covering could often be directly traced in a nerve fibre, it was evident that one had to deal only with swollen axis-cylinders.

The retina was rudimentarily developed throughout the region of medullated fibres. For several millimetres from the margin of the papilla, all the layers except that of the nerve fibres and the pigment epithelium were wholly absent, then the inner and outer nuclear layers began in a wedge-shaped form, almost without an intergranular. The inner nuclear layer became better developed as it approached the periphery, while large ganglion cells gradually appeared, though sparingly. When places above and below, equidistant from the papilla, were compared, the retina above was always seen to be considerably diminished. Below, the retina began at the papilla. It was certainly diminished in the region of the medullated fibres, but not so markedly as above, and before they ceased peripherally it had attained its normal structure. The medullated fibres, which likewise appeared below at the papillary margin, but more in gradual transition from the non-medullated, formed a triangular patch, the longest measurement of which was about a papillary diameter. Expressed differently, the length of the upper layer of fibres was 14 to 16*mm*, that of the lower 1½*mm*. The breadth also was less.

In addition to the wide expanse of medullated nerve fibres, another abnormality attracted attention. Both on the head of the optic nerve and also spreading out above and below its entrance, there was a tissue on the limiting membrane which was stained an intense red by Van Giesen's method. It covered the limiting membrane in a layer of varying thickness, and accompanied the layer of medullated nerve fibres throughout its whole extent to the ora serrata, where it became thicker in places and overran the limits of the medullated fibres, so that it was present in some places where no such fibres existed. Its maximum thickness was 65*mm*. In many places it had a homogeneous appearance. Its outer layers were compact, connected by fibres lying close

together, while its inner part was loose and had an almost reticulated structure which enclosed large spaces. In various places sections of capillary vessels could be seen. A distinct line of demarcation from the vitreous could not be clearly made out in all places, perhaps because the latter became detached during the process of hardening. Here and there could be seen pale granules, characteristic of the limiting membrane of the vitreous. The membrana limitans interna sometimes could be clearly traced, but in other places it was broken and this fibrous tissue passed through, with the retina obliquely or vertically to the bundles of fibres running in connection with the latter. From their reaction to the various staining agents, these binding fibres appeared to be principally Müller's supporting fibres. In the preparations stained with hæmatoxylin-eosin, there were spindle-shaped nuclei as well as roundish nuclear forms, which were oblique sections of the former. It is evident that this was connective tissue. It contained no elastic elements.

The right eye had seven dioptries of hyperopia and was perfectly spheroidal. The sagittal, transverse, and vertical diameters each measured *22mm*, and the cadaveric radius of the cornea was greater than that of the left.

I will now subjoin a description of the microscopical condition found in two other eyes in which medullated nerve fibres were observed during life. The details of the ophthalmoscopic appearances have been published already by Professor Elschnig, so I shall pass over them briefly.

Case 4.—Left eye: The medullated nerve fibres extended downward from the margin of the papilla for almost a papillary diameter.

Microscopically the entrance of the optic nerve was topographically normal, except that there were a bilateral bulging toward the sclera in the region of the scleral lamina, and a medial spur formation of the choroidea, together with recession of the lamina vitrea with the pigment epithelium, thus exposing anatomically a connective-tissue ring. There was a duplicature of the retina at the medial margin of the optic nerve.

In the optic nerve the medullated fibres ended suddenly at the outer limit of the lamina cribrosa and were separated from their non-medullated continuations by a sharp line of demarcation

concave inward. The lamina cribrosa itself had a close texture and nowhere contained medullated fibres. The axis-cylinders regained their sheaths in the choroideal segment of the optic nerve, and formed a thick, quadrangular, circumscribed patch, which spread out almost symmetrically on each side of the central vessels and was bordered by a small marginal zone of naked axis-cylinders. The medullated nerve fibres radiated only a little over the margins of the papilla into the retina of each side, but some could be traced farther into the periphery of the retina, or reappeared for short distances among the non-medullated fibres. They had numerous varicosities, which did not differ from those previously described.

Right eye: The medullated nerve fibres formed three flame-bordered patches, almost a papillary diameter broad, attached to the margin of the papilla above, below, and medially.

Microscopically the intervaginal space and the form of the sclerotic canal were about the same as in the left eye.

The middle layers of the retina corresponding to the medullated fibres were very thin, so much so that at the margin of the optic nerve a very delicate layer of intermediate tissue alone separated the latter from the pigment epithelium. The medullated nerve fibres were present in greater number and extent than in the left eye. They ended in the optic nerve at the outer margin of the lamina cribrosa, forming a line concave within, and reappeared internally from this line in large areas which were rather sharply demarcated from their non-medullated surroundings and were united by occasional loose bundles of fibres.

The smallest zone, which comprised the lower part of the head of the optic nerve, began close to the inner side of the lamina cribrosa beneath the central vessels. It was united by loose bundles of fibres with the second zone, which also lay in the lower part of the section, so as to form an almost right-angled triangle, the hypothenuse of which was turned toward the interior of the eye. The third and largest zone, situated above, was shaped like an obtuse-angled triangle, with its longest side to the choroidea. In this the medullated nerve fibres extended a considerable distance into the retina, the layers of which were compressed into a thin wedge at the optic nerve. Throughout this region the medullated fibres formed a dense tissue in which naked axis-cylinders were occasionally met with. Varicosities were abundant.

In the medullated bundles of the optic nerve were occasional

light places which could be readily distinguished from the blue-black margins of the medullated bundles. Some were bridged over by fine fibres in the direction of the axis of the nerve, into others the ends of fibres projected, as if broken off, from the anterior or the posterior pole, while still others persisted as very small slits. Part of these appeared to be empty, part to be filled with contents, either finely granular or homogeneous, which did not stain well. The nature of this condition is uncertain; perhaps it was a congenital anomaly.

It is not yet fully understood what causes the appearance of medullated nerve fibres in the retina. Most authors have found in the immutability of the ophthalmoscopic condition, its sharp limitations, and the constancy of its functional relations a basis for the theory that it is a congenital, physiological condition. Schmidt-Rimpler did not consider it to be such. From the fact that "of all the cranial nerves in the infant or fœtus the optic is the most backward in the formation of medulla, so that the presence of medullated fibres in the retina at birth is as good as excluded," and from experiments on rabbits' eyes, in which the medulla begins to develop on the last day before the eyes are opened, to be completed in from 2½ to 3 weeks, von Hippel concluded that it is not a congenital anomaly in the true sense of the word, but that only the predisposition to its development is congenital.

Another argument in favor of the congenital predisposition to this anomaly is furnished clinically. In almost all cases there are other congenital deviations from the normal, as shown by the statistics compiled by Kölliker and by quotations from the literature on the subject. In the cases here described there were present as congenital concomitant phenomena a persistent hyaloid artery, a cavernous angioma, and in the three eyes examined microscopically an unusual form of conus, facts which seem to indicate that a congenital tendency lay at the bottom of the formation of medullated fibres in the retina. The anatomy of the retina in connection with an extensive formation of the medullated fibres likewise supports this idea. In all three of these cases the retina was very rudimentarily developed in the region

of those fibres, particularly in the left eye of Case 4, where there was a duplicature of the retina in the middle of the margin of the optic nerve. Hence the development of medullated nerve fibres in the retina occurs by preference in such eyes of persons as already have congenital defects, whence the conclusion arises that it is not an accidentally acquired condition, but one dependent on congenitally predisposing factors.

What these factors are has not yet been satisfactorily determined, but the growth of connective tissue on the internal limiting membrane, which I have described, contributes toward the solution of the question. The ramification of this layer of connective tissue, its close attachment to the layer of medullated nerve fibres, its connection with the central cord of connective tissue and with the connective tissue of the vessels in general, its dimensions, and the presence in it of blood-vessels are very striking. It resembles the connective-tissue sheaths of the bundles of fibres in the optic nerve, and the comparison suggests that this tissue occupies the same nutritive relation to the medullated nerve fibres in the retina that it holds in the optic nerve, an idea which is favored by the fact that it contains blood-vessels.

While under normal conditions the lamina cribrosa forms a natural obstacle to the development of medullated sheaths, which proceed centrifugally from the brain, any continuation or expansion of the central connective-tissue could be thought to be a supporting and furthering element in the formation of such sheaths. The presence of this connective-tissue is doubtless a congenital condition produced during the development of the eye. In this congenital connective-tissue and in its peculiar association with the medullated nerve fibres can be found the congenital predisposition to which von Hippel ascribed the development of medullated nerve fibres in post-embryonal life. Furthermore, in cases in which there is a great development of medullated fibres there is often a connective-tissue formation of this kind. It may perhaps be added that in almost all cases in which the medullated nerve fibres cover a great extent the beautiful radiations which usually characterize the condition are

absent where the medullated layer is thickest. Hence in many of these cases, as in Case 4, a congenital development of connective tissue was present. The ophthalmoscopic picture of Case 2 is confirmatory of this theory, as is also a picture in Oeller's atlas (A, Table V), which shows a fold running directly across a patch of medullated nerve fibres.

REPORT OF MEETINGS OF THE OPHTHALMOLOGICAL SECTION OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. H. W. WOOTTON, Secretary.

MONDAY, OCTOBER 7, 1904. THE PRESIDENT, DR. DUANE, IN THE CHAIR.

Dr. C. Koller read the history of a case of **posterior cortical cataract** due to injury to the cornea and anterior capsule. It concerned a young man who, while splitting wood, was struck by a piece hitting his left eye with considerable force. On examination a small perforating flap-wound of the cornea was found; at the time no other injury to the eye was apparent. Healing was normal. When after six days a more thorough ophthalmoscopic examination was made with dilated pupil, a delicate star-like, somewhat diffuse opacity was seen in the region of the posterior pole of the lens. Three and a half weeks later the corneal scar appeared smooth; the opacity at the posterior pole was smaller, but was much better defined. Vision was $\frac{6}{18}$; with a stenopæic slit it was $\frac{6}{12}$. The better definition of the posterior opacity permitting now a better scrutiny of the anterior part of the lens, a condition was revealed which most likely had existed before, but had escaped notice. In the anterior capsule of the lens, exactly corresponding to the inner angle of the corneal wound, was a fine dot, surrounded by a delicate frost-like opacity in the most anterior layer of the lens. Three years later (at the present time), the conditions were practically the same.

Posterior cortical cataract of traumatic origin would seem to be very rare, if one judged from the very few cases that have been recorded in literature. Most likely the affection is not so

very uncommon, its presence perhaps in many cases being hidden behind the extended anterior opacities, which are the common sequel of perforating injuries to the lens or contusions of the eye. It would not even be surprising if systematic experimental investigation were to show that it is quite common after traumatism to the lens. In part of the recorded cases it appeared after a piercing wound of the lens, in others after a simple contusion of the eye, without tearing of the lens capsule or the suspensory ligament. It is remarkable that in the cases of perforating wound the lens-wound not necessarily reached to the posterior cortex, and in fact was entirely peripheral in some cases. The opacity being a part of the posterior cortex shows the structure of the latter, and has the shape of a star, copying the arrangement of the lens-fibres at the posterior pole of the lens. It develops in the days following the injury, and may progress to complete and total cataract. In most cases it remains stationary after clearing somewhat in the first weeks. Sometimes this clearing is very considerable, and the opacity has even been observed to disappear entirely. This makes it very likely that the cause of the opacity is not always destruction or alteration of the lens-fibres, but may be due to some deposit between them, which can disappear.

Various theories have been advanced to explain the origin and the true nature of this curious formation, but in the absence of pathological examinations we are limited to conjectures. According to Fuchs, the quick development and the possibility of a total disappearance of these opacities points to their not being caused by a change of the lens fibres; he thinks it likely that preformed lymph-spaces in the lens are gorged by a liquid which can disappear. Such interfibrillar spaces had been demonstrated by Schloesser in his specimens of experimentally produced cataract (in animals); they formed a system of spaces, which partly were concentric around the nucleus, and partly parallel and near the posterior surface of the lens. Similar spaces had previously been described by von Becker in (human) lenses, which he had treated with hardening fluids after removing them from the eyes.

Since that time investigations have been made with newer methods, and the weight of opinion is against the assumption of preformed lymph-spaces in the normal lens. Leber (*Die Circulations- u. Ernaehrungsverh. des Auges*, new edition of *Graefe-Saemisch's Handbuch*) rejects the theory that lymph circulates

in interfibrillar spaces altogether, and says that all thorough investigations of newer date show that the lens-fibres simply lie close to one another and no measurable gaps between them are present; a minimal quantity of cement substance must of course exist, as without it the contours of the lens-fibres would not be visible. Quite recently zur Nedden has published an article on this subject, describing three cases of traumatic posterior cataract, adding two others, in which an attempted discission of the anterior capsule had resulted in the formation of posterior cortical cataract. Koller has had several similar experiences, when, after trituration for maturing senile cataract, instead of the expected progress of the anterior opacity, the posterior cortex became very opaque. Zur Nedden comes to the conclusion that in these operative cases, as in the traumatic without opening of the lens-capsule, considerable momentary displacement of the lens within the capsule takes place, leading to a loosening of the lens-fibres on the posterior capsule. These attachments have, according to Leber, the same protecting influence against the entrance of fluids as the epithelium of the anterior capsule. Zur Nedden assumes that, in consequence of this hypothetical loosening, some fluid from the vitreous enters into the cement substance between the fibres, and thus produces the opacity, which can grow less or disappear entirely, according to the less intense or trifling alteration of the cement substance. Why this loosening of the lens-fibre attachments should take place at the very pole of the lens, and why it should be absolutely symmetrical, is not explained by this hypothesis. The curious and interesting phenomenon, of the lens reacting with a change at its posterior pole to injuries inflicted on its anterior surface, can be satisfactorily explained only by further experiments and pathological investigations.

Dr. H. J. CLAIBORNE read the history of a case of **Parinaud's conjunctivitis.**

The patient, a young man of seventeen years, on April 7, 1904, gave the following history: The week before, his right eye became inflamed and immediately grew worse. Two days later, the lids were so swollen that the eye was completely closed. His face was also swollen, and matter ran between the lids, sticking the lashes together. The malar region was excoriated, apparently from the pus. The eye remained closed for several days. At the time of Dr. Claiborne's first observation of the case,

the status was as follows: The upper lid very much swollen; when it was raised with the thumb the cornea could scarcely be seen; red and raw in places on the edge where the lashes were matted together. There was slight secretion and a number of excoriated points on the malar region. There was also some excoriating secretion in the nose. The other eye was normal. On everting the lower lid, the conjunctiva presented granulations both isolated and confluent, and flakes of yellow pus lay between the folds. The upper lid was too thick and sensitive to be be everted. The pre-auricular gland was considerably swollen. There were six or seven enlarged glands on the right side of the neck, extending almost down to the clavicle. No swollen glands were on the left side of the neck. Two days later, the upper lid was everted and found to be in a condition very similar to that of the lower, although there was no brawn, as one usually sees in gonorrhœa and diphtheria. There was slight infiltration of the cornea on the outer side. The first report of the bacteriological examination of the pus stated that the gonococcus was present, but, in view of the fact that the affection had lasted ten days, and according to the patient's statements, was no worse at the time Dr. Claiborne saw him, and in view also of the scarcity of the pus, Dr. Claiborne requested that another examination be made. The second examination revealed some cocci in small number, without any well-defined arrangement or constant morphology. After incubating, a culture of blood serum revealed an abundant growth of colonies of the staphylococcus pyogenes aureus. A diagnosis of Parinaud's conjunctivitis was made. Treatment consisted in ice-bags and boracic-acid flushings, in conjunction with nitrate of silver. Under this treatment, he recovered almost completely in a week or ten days. He returned to school, was comfortable until August 15th, when his right eye became slightly inflamed. This inflammation was abated by the use of argyrol. September 12th, his eye became inflamed again, and presented the appearance of ordinary acute conjunctivitis. There was a mild secretion, no swelling of the lids, no swelling of the glands. In regard to the etiology of Parinaud's conjunctivitis, the possibility of animal infection has been suggested. There was no such connection in this case. Dr. Claiborne thought that in his case it was necessary to consider the possible existence of three other conditions: gonorrhœa, acute trachoma, and tuberculosis. He eliminated

gonorrhœa, for the reasons already given; and, in addition, for the reason that the boy did not have the disease. Reaction had been too grave and the lid too much swollen to justify a diagnosis of trachoma. Tuberculosis was relatively improbable, on account of the secretion and the exceeding thickness of the upper lid, and when bacteriological examination revealed the presence of the staphylococcus, he felt that the diagnosis of infective conjunctivitis was reasonably established. The case recovered very rapidly, more rapidly in fact than most, although there had been two recurrences of the conjunctival inflammation, which, in Dr. Claiborne's opinion, were probably due to the regrowth of the original infectious bacteria.

In Dr. Claiborne's opinion, Parinaud's conjunctivitis was more frequent than was commonly supposed, and a more careful inspection of the preauricular and cervical glands will lead to detection of cases which ordinarily escape observation. Inasmuch as it cannot be definitely stated that any specific cause had been found for the disease, it would seem impossible to make any firm and fast diagnosis. Of the symptoms that have been observed, those which seem to be absolutely constant are the swelling of the preauricular and cervical glands and the characteristic appearance of the conjunctiva already described. These two symptoms seem to be ground for the diagnosis, which should be corroborated by the finding of staphylococci, diplococci, and streptococci.

Dr. W. P. MARPLE presented a case of **congenital ptosis,** operated upon by the method of Gruening, or of Gillet de Grandmont. The tarsal cartilage had been removed from the conjunctival surface. The result was excellent, and as the other eye had not yet been operated upon, the contrast was very apparent. The ptosis in the other eye was exceedingly marked, the lower edge of the upper lid covering the pupil.

In the discussion of Dr. Koller's case, Dr. KIPP did not think that the development of posterior cortical cataract after injury was so very rare. He had seen a number of such cases.

Dr. POOLEY believed that in these cases the posterior capsule was ruptured.

Dr. LUCIEN HOWE thought that as a certain amount of clearing up of the opacities in the human lens was possible, so in these cases the cataract might at first have been more extensive, and

the anterior portion then having cleared, the posterior opacity alone might have been left.

Dr. KOLLER thought the conditions much more common than was usually supposed. He thought there was little written upon the subject, and not more than ten or fifteen cases had been recorded.

Dr. GRUENING had described a case, and did not consider the condition so very rare.

Dr. WEEKS, in reference to Dr. Claiborne's case of Parinaud's conjunctivitis, stated that he had seen four cases of this disease, and in all there had been superficial ulcerations between the elevations of the conjunctiva. These Dr. Claiborne had not described. Recurrences were frequent. One of his cases suffered from a relapse in ten days. He had seen the cervical glands suppurate. He had failed to find any distinctive micro-organism. Treatment was very simple: cleanliness and good surroundings.

Dr. CLAIBORNE stated that he had failed to find superficial ulcerations in his case.

Dr. GRUENING thought that the result in Dr. Marple's case of ptosis was very good, particularly as the infraorbital sulcus had been restored. He stated that the difference between his method and that of Gillet de Grandmont consisted in the fact that whereas Gillet de Grandmont removed both muscle and tarsus, Dr. Gruening removed the tarsus only.

Dr. KIPP remarked that the eye could not be entirely closed.

Dr. WEEKS stated he had performed the operation a number of times, and liked the result very much.

Professor THEODOR BEER, of Vienna, demonstrated the **refraction and accommodation of the eyes of some of the lower vertebrates.**

Dr. Beer explained that while most land animals were far-sighted, the fishes and reptilia are usually near-sighted, and were compelled, by the use of a peculiar muscular mechanism, to accommodate for every distance. In some cases this was effected by retraction of the lens; in other cases, by propulsion of the posterior pole of the eye. Both of these processes were very beautifully demonstrated by Professor Beer, in fresh specimens.

In many vertebrates, their mode of living had much to do with the degree of accommodation which they possessed. The elephant, for instance, rarely had to look at anything closer than the

end of his trunk, and had comparatively little accommodative power, while the apes, who were compelled to observe objects much closer, possessed considerably greater accommodative power. For further particulars on this subject, the reader is referred to Beer's publications. The thanks of the Section were tendered to Professor Beer.

MONDAY, NOVEMBER 21, 1904, THE PRESIDENT, DR. DUANE, IN THE CHAIR.

Dr. M. L. FOSTER described the result in a case upon which he performed Krönlein's operation four years previously. The patient when first seen four years ago exhibited a marked degree of exophthalmos of the left eye, the cornea of which was turned upward and inward and the eye had lost all power of abduction. Palpation in the lower-outer part of the orbit revealed a freely movable smooth firm tumor apparently about the size of a chestnut. Vision was uncertain as the child could not read, but saw at least $\frac{20}{100}$. There was no optic neuritis or other lesion in the fundus. From the very slow growth of this tumor, its mobility, apparently small size, and the absence of neuritis, it was thought to be benign and not connected with periosteum or the optic nerve, and capable of being easily enucleated through an incision into the conjunctiva, but as there was an element of doubt as to whether it could be enucleated easily, it seemed best to make the primary incision in such a manner as to facilitate the resection of the outer wall of the orbit if this should be found necessary. Finally, Krönlein's operation was performed and revealed the presence of a large pyriform tumor, attached by its narrow end to the eyeball with its base at the apex of the orbit and corresponding longitudinally with the course of the optic nerve which could not be found elsewhere. The tumor exhibited a bluish color characteristic of a collection of fluid in a thin sac of connective tissue. The tumor was aspirated and three drachms of fluid then withdrawn. The tumor then collapsed. During this aspiration, the needle was introduced two or three times without obtaining fluid, possibly because the point of the needle was embedded in the tissue of the tumor itself. This may possibly have been the cause of the subsequent atrophy of the nerve. The fluid proved, upon analysis, to be cerebro-spinal. The case was one of **distension of the sheath of the optic nerve with cerebro-spinal fluid,** a condition which has been rarely, if ever

before, described, and a diagnosis could hardly have been made without an enlargement of the means of access to the contents of the orbit.

When seen on November 24, 1904, the left eye was still somewhat more prominent than the right. There was apparent parallelism of the visual lines of the two eyes. Power of abduction in the left eye was incomplete. There was no deformity where the bone had been chiselled. Vertical cicatrix external to the outer margin of the left orbit was the only deformity left by the operation. Vision : perception of light.

Dr. SCHAPRINGER exhibited a patient in whom **extirpation of the lachrymal gland** had been performed **for occlusion of the lachrymal sac.** Epiphora had existed for four years.

Probing had been attempted, but no probe had been passed into the nose.

The tearing was constant, and examination revealed the fact that both canaliculi had been slit, but no probe had been introduced into the sac. An attempt to force the passage did not seem advisable, and even if successful, treatment would have been prolonged. Both portions of the lachrymal gland of the right side were extirpated, and tearing has ceased, although the eye is still somewhat irritated, due probably to the fact that the patient works in a tobacco factory. He can still weep slightly with the affected eye.

Dr. SCHAPRINGER also presented a case of **cataracta heterochromia.** The patient was a man thirty years of age. The right iris was a dull blue and that of the left eye brown. Astigmatism in both eyes and some presbyopia. When the patient looked downward and inward, an opaque line was distinctly visible in the right lens. The patient thought that his irides had not always been different in color, but that about six years ago, after a severe illness, the nature of which was unknown, the differing colors were noticed. Dr. Schapringer believed that the heterochromia of the irides was acquired, and he had seen such cases develop an opacity of the lens in the eye with the lighter-colored iris. In this patient's case the little opacity of the lens did not interfere with sight. The case was chronic and non-inflammatory. There was no history of redness, and Dr. Schapringer had been unable to discover any deposits on Descemet's membrane. Dr. Schapringer claimed priority in the theory of the acquired, as opposed to the congenital, nature of these

opacities in 1899 and 1900. The opacity of the lens did not develop in the eye of the darker iris.

Dr. P. H. FRIDENBERG presented a sketch of the **fundus** which represented **fibrillary œdema of the retina.** The injury was a contusion of the globe by a blow with a sandbag. With the exception of a slight bruise of the lower lid and a somewhat tremulous iris, no evidence of damage appeared. The media were clear. The pupil dilated very slowly under atropine. It was then found that the macular region was occupied by a peculiar oval light reflex, of angular wavy outline and silvery or milky-white hue. Radiating from this were numerous highly refracting white striations corresponding to the course, size, and location of nerve fibres. There were indications of perivascular œdema and a few œdematous nerve fibres running from the disc to the macula. This picture is quite different from the surface œdema of Berlin's commotio retinæ, of which it may be considered clinically a mild variety. The analogy of these œdematous nerve-fibres to lens-fibres in a state of imbibition, both as to pathogenesis and optical characteristics, is striking. In some cases the œdema may be absorbed and the opaque nerve fibres clear up (as cloudy and swollen lens fibres may), while in other cases the fibres remain white, and become sclerosed. The latter condition was obscured in a number of cases previously reported.

The full description of the case, with the reproduction of a beautifully colored drawing, will appear in a later number of these ARCHIVES and also in its German edition.

Dr. ARNOLD KNAPP presented a case of **acute periorbital abscess, secondary to ethmoiditis,** in a child eight years of age, upon which he had operated.

On August 11, 1904, the patient was taken ill with fever, chills, herpetic eruption on nose, vomiting; the left eye became "swollen" and painful. No discharge noted from nose. She visited the dispensary on August 17th, and the left eye was found to be pushed forward and out. A hard circumscribed swelling could be felt just back of the lachrymal fossa. The nose and eye were normal.

Operation, August 19th.—Curved incision along inner margin of orbit. The periosteum was detached together with the pulley, which was found directly adherent to the orbital margin by fibrous adhesions, and there was no prominent projection of

bone which usually marked the site of the pulley. On detaching the periosteum from the os planum, pus appeared coming from a perforation just anterior and below the posterior ethmoidal foramen. The periosteum forming the outer wall of this abscess cavity was very much thickened. The ethmoidal cells were curetted, removing muco-pus and swollen mucous membrane, making a wide opening into the nose. There was no communication anteriorly with the frontal sinus, so that that cavity was not explored. A small piece of gauze was introduced in the anterior part of the wound, and some into the nose. These were removed three days later. The orbital wound healed without reaction, and the patient was discharged on September 3d. On examination distinct diplopia. This had disappeared on September 15th, when the wound had healed, without deformity, and the eye had resumed its normal position.

Dr. SARIL stated that in Dr. Schapringer's case of **heterochromia** he had noted an increase of tension. There were deposits of Descemet's membrane, and the right anterior chamber was slightly deeper than the left. The process was inflammatory and probably had caused absorption of pigment on the posterior surface of the iris, thus accounting for the light color of the iris. The inflammatory condition also accounted for the cataract.

Dr. LINN EMERSON read a paper entitled **The comparative use of atropine and homatropine for cycloplegia.**

The paper dealt with the experience gained in testing the refraction of forty cases under homatropine, and then subsequently employing atropine in the same cases.

7	patients	were	from	5–10	years	of	age.
20	"	"	"	10–15	"	"	"
3	"	"	"	15–20	"	"	"
3	"	"	"	20–25	"	"	"
7	"	"	"	25–30	"	"	"

The comparative results were as follows:

The refraction was the same under homatropine and atropine in 22 cases.

6 cases accepted a .25 D. sp. more under atropine in one eye.

7 cases, .25 D. sp. more under atropine in both eyes.

2 cases, .50 D. sp. more under atropine in both eyes.

2 cases, .25 D. sp. less under atropine in both eyes.

1 case, .25 D. cylinder more under atropine in one eye.

As will be observed, there was but one case in which a change in the cylindrical correction was noted. Of the two cases that accepted a + .50 D. sp. more under atropine, one possessed a hypermetropia of 6 D. Of forty cases examined, thirty-seven showed no greater variation than + .25 D. sp. From Dr. Emerson's observation, he deduced the following results: That sixty per cent. of his refraction cases under thirty-five years of age required the use of a cycloplegic, and that homatropine, properly used, is a reliable cycloplegic for patients of all ages.

Dr. Emerson employed a three and one-half per cent. solution of homatropine hydrobromate, of which one drop was instilled in each eye for fifteen minutes for six times, beginning two hours before the examination.

Dr. H. KNAPP stated that the ciliary muscle and the internal recti were associated in the function of accommodation. He thought that this fact might be utilized in determining the refraction in a great many cases, without resorting to the use of cycloplegics. Co-ordinate nerve impulses show themselves when the function of either can be separated. The means of separating them are by spectacles and prisms. When a hyperope of two dioptries sees distinctly at a distance, he accommodates to the amount of two dioptries. The same nerve impulse is sent to the internal recti, which the phorometer or other prism arrangements would indicate by about 2° of esophoria. The following cases will illustrate this: (1) Female, twenty-five years of age, teacher; asthenopia from hypermetropic esophoria; vision, $\frac{20}{20}$ in each eye. Esophoria for distance, $1\frac{1}{2}°$. The patient's refraction and muscular error were corrected by a + $1\frac{1}{2}$ sp. lens. (2) Female, thirty-three years; asthenopia; had previously squinted. Esophoria of $2\frac{3}{4}°$ was corrected by + 2.75 sp. (3) Male, thirty-five years; asthenopia. Phorometer at distance showed orthophoria; with a − 1 D. sp., esophoria, 1°.

Dr. POOLEY thought that cycloplegics were not so often indicated as Dr. Emerson's paper had stated. He restricted their use to cases in which the ophthalmoscope and ophthalmometer did not agree with the test lenses. These cases he thought were rare. He thought that only the manifest hypermetropia should be corrected at the first examination. Glasses subsequently, from

time to time, could be gradually strengthened. As age increased, cycloplegics became less and less necessary, so that, as far as he was concerned, he found them practically unnecessary except in young people. He preferred homatropine and found it quite reliable, and he did not think that any cycloplegics except atropine and homatropine were to be relied upon. In using homatropine, he employed the three and one-half ($3\frac{1}{2}$) per cent. solution, making instillations every fifteen minutes for an hour. In some few cases homatropine did not succeed and atropine had to be employed. These cases were very rare. He had seen one case of glaucoma in a young subject after two or three instillations of homatropine, and we must, he thought, be prepared in any case to employ a myotic after the use of the cycloplegic.

Dr. MARPLE thought that as a rule homatropine was as satisfactory as atropine. Cycloplegics made one feel more certain, and in cases in which we were doubtful as to the source of their symptoms, if symptoms disappeared while patient was under a cycloplegic, the probabilities were that glasses would better their condition. He had seen one case of glaucoma caused by a cycloplegic in a patient of middle age. It was temporarily relieved by eserine, but required later an iridectomy. He had also seen a young patient develop mild mania at night, apparently from the use of $3\frac{1}{2}$ per cent. homatropine. Chemical tests showed that the solution in question actually contained atropine, although put up by a perfectly reliable house.

Dr. H. H. TYSON considered that a cycloplegic was indicated in testing children and young adults, and was contra-indicated in adults over forty-five years of age, and in those with a tendency toward increased tension. In cases of strabismus and spasm of accommodation, he used atropine in preference to homatropine. In giving atropine for cases of strabismus and spasm of accommodation, he prescribed a one per cent. solution, and ordered one drop to be instilled three times a day for two or three days. In using homatropine solutions, he thought that, although various strengths might be employed, the effect produced was about the same in each case in one hour's time, providing the same quantity of the drug had been used. The advantage of using the stronger solution consisted in the fact that the maximum effect was produced in a trifle shorter time than by a weak solution. By dropping the solution directly upon the cornea, a better result was obtained than when it was instilled into the

lower cul-de-sac. The length of time which the effect lasted depended upon the quantity of drug used. Solutions of atropine paralyzed the accommodation for from eight to twelve days. Homatropine solutions required from twelve to thirty-six hours for the effects to pass away. To prevent unpleasant after-effects from cycloplegics, one should see that solutions were properly made and free from acid, and that there was no tendency to increase of tension. Care should be exercised in instilling the solution, in order to allow none of it to run over the lids and into the mouth. After instillation the patient should compress the lachrymal sac for about ten minutes, and in adults of thirty-five years or over or in those in whom any suspicion of tendency toward increased tension existed, or when one wished to hasten the return of accommodation, a couple of drops of a one per cent. solution of pilocarpin should be used.

Dr. W. E. LAMBERT expressed himself as absolutely opposed to the systematic use of any cycloplegic. He admitted that in a few cases cycloplegics were required, but thought that with the ophthalmometer, ophthalmoscope, and the shadow test performed after dilating the pupil with cocaine, the accurate estimate of at least the amount of astigmatism present could be made, and this was the important point. Full correction of the hypermetropia he thought generally inadvisable. He considered cycloplegics necessary in young children and in cases of convergent strabismus.

Dr. FRANCIS VALK thought that when the results of our various examinations did not agree, cycloplegics were necessary, and he always used atropine. Cycloplegics were seldom needed for retinoscopy in children, for, as a rule, children's pupils were large. He thought cycloplegics were never necessary after forty years of age.

Dr. F. N. LEWIS did not use cycloplegics to any great extent, but thought that the personal equation of the examiner exerted considerable influence in his relation to cycloplegics. One man, for instance, would prefer to be very exact, and such a man would probably use cyloplegics a great deal, whereas another, knowing that in most cases full correction could not be prescribed, would be content with a partial and less exact estimate of the refraction. One per cent. atropine solution was, in his opinion, most satisfactory as a cycloplegic, although undoubtedly the most inconvenient.

Dr. R. OPDYKE rarely used cycloplegics. He preferred to increase the strength of the glasses from time to time, rather than to be compelled to reduce the strength, as was sometimes necessary after a cycloplegic had been employed. He had seen the sulphate of homatropine in one per cent. solution produce nervous symptoms.

Dr. H. W. WOOTTON used cycloplegics a great deal. He thought that all cases of marked astigmatism in young people should have their refraction tested by their aid. He did not believe that the results with the retinoscope were reliable without cycloplegia. He thought that, as a rule, with increasing age, cycloplegics became less and less necessary, but there was one class of cases in which they should sometimes be employed, namely, cases of hypermetropia and hypermetropic astigmatism in persons nearing forty-five years who had never worn glasses. In these cases the accommodation had been strained for years, and sometimes there resulted a condition of chronic spasm which required cycloplegics before the astigmatic correction would be accepted. He called attention to atroscine used in one per cent. solution as recommended by Dr. Macklin of this city. This he considered a reliable and powerful cycloplegic, occupying a place midway between atropine and homatropine. The paralysis of accommodation resulting from its use lasted as a rule about five days, and paralysis was, almost invariably, complete in one hour after the instillation of one drop of a one per cent. oily solution.

Dr. DUANE used cycloplegics in about ninety per cent. of his cases, and at a much later period of life than was usual. He frequently had most trouble in getting accommodation to relax in persons of from thirty-eight to forty-eight years of age, and this was due to the fact that in these cases we were dealing with a hardening lens. In children the lens was plastic, it was more easy to get relaxation, and homatropine could be employed even in cases of squint. He did not believe that the ophthalmoscope was reliable even in expert hands. He did not agree with Dr. Knapp's statement that the very frequent and reliable association of esophoria with hypermetropia and exophoria with myopia could be utilized in determining the refraction. Some of his most inveterate cases of exophoria had been associated with hypermetropia. In using homatropine he used a two per cent. solution, which, it appeared to him, produced its maximum effect in about

one and one-half hours. He was very much in the habit of employing eserine afterwards.

Dr. LINN EMERSON, in conclusion, said he did not like sulphate of homatropine and had seen it produce unpleasant effects, but he had never seen any bad results from the use of the hydrobromate. One had to be certain that his preparation was fresh. Cases with a small degree of astigmatism, a quarter of a dioptry for instance, very frequently required a cycloplegic, and, in his opinion, were markedly relieved by their correction. He dropped his solutions in the lower cul-de-sac, and had seen no advantage in the practice of dropping them on the cornea. He often employed homatropine in persons thirty-five years of age and upward.

REPORT OF THE MEETINGS OF THE OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM.

By Mr. C. DEVEREUX MARSHALL.

THURSDAY, OCTOBER 20, 1904. A. STANFORD MORTON, F.R.C.S., VICE-PRESIDENT, IN THE CHAIR.

Mr. Nettleship communicated **notes on the blood-vessels of the optic disc** in certain mammals (eighteen species) and a few marsupials (three species); no monkeys were included. The eyeballs were sent to him by Mr. F. E. Beddard, F.R.S., from the post-mortem room of the Zoölogical Gardens.

The observations were based on the microscopical examination of both transverse and longitudinal sections of the opic disc and the contiguous parts of the optic nerve. It was found in many mammals that the retina is almost entirely supplied by arteries derived from the choroidal system—cilio-retinal vessels,—that reach the retina by passing round the sclero-choroidal border of the disc. Ophthalmoscopically this arrangement often (as for instance in the carnivora) causes an appearance somewhat like that of a deep glaucomatous cupping, and such cupping has been stated by Lindsay Johnson to be present in these eyes. But no cupping was found in any of the eyes examined microscopically by the author of the present paper, nor is the assumption of cupping necessary in order to account for the appearance.

Another interesting observation is that, even when the cilio-retinal vessels carry virtually the whole retinal supply, the central artery is seldom if ever quite absent, though often reduced to a minute vessel entering the optic nerve close to the eye. In some species, such a minute arteria centralis becomes much enlarged at the lamina cribrosa by tributaries from choroid or sclerotic,

the short trunk thus formed breaking up almost immediately in the disc for distribution to the retina; and ophthalmoscopic examination of such an eye would naturally lead to the erroneous conclusion that the supply was from a large arteria centralis as in man. Various other points were alluded to. The paper was illustrated by microscopical drawings.

Mr. LINDSAY JOHNSON commented on the paper.

A paper on the **bacteriology of the conjunctiva** was read by Dr. W. B. INGLIS POLLOCK, in which he reviewed and analyzed 204 cases of conjunctivitis in which a bacteriological examination had been made. There were 145 cases of acute muco-purulent conjunctivitis, including the acute contagious conjunctivitis of Weeks. Of these, 108 were due to the Weeks bacillus, 7 to the Morax diplobacillus, 1 to the pneumococcus, 2 to the gonococcus, and 6 to the staphylococcus pyogenes aureus. There were 3 of mixed infection, and 18 gave indefinite or negative results. In 20 cases of subacute conjunctivitis (Morax), the diplobacilli were found 14 times, Weeks bacillus once, and there were 5 indefinite or negative results. In 9 cases of purulent conjunctivitis, 4 were due to the gonococcus, 3 to Weeks, once to the pneumococcus, and once mixed with bacillus subtilis.

In 10 cases of ophthalmia neonatorum, gonococci were found 8 times, the pneumococcus once, and once the result was negative. One case of membranous conjunctivitis from staphylococcus pyogenes aureus. Several other cases completed the series.

The general symptomatology of the forms associated with individual organisms was gone into and cases related bringing out special points. The advantage of a bacteriological examination of the conjunctiva prior to operation was illustrated by some cases.

Cases of phlyctenular conjunctivitis only showed staphylococcus pyogenes aureus or the xerosis bacillus, and these and especially the latter, are innocuous in the conjunctiva of almost all cases. We are consequently reduced to the theory of an endogenous origin, and Bruns has shown that by injecting sterilized tubercle bacilli into the arterial system he can obtain nodules very like phlyctenulæ. We cannot as yet adopt a pure bacteriological classification of conjunctivitis, but such is coming nearer. For ascertaining the presence of gonococci a bacteriological examination is essential, and it should be carried out in all cases of membranous conjunctivitis. The paper was illustrated by lan-

tern slides which had been prepared for a course of lectures given by Dr. Freeland Fergus.

Mr. Bishop Harman demonstrated a new ophthalmoscope, and Mr. E. E. Maddox showed some pigmy needles for suturing cataract wounds and some delicate electric connections for use after cataract extraction.

THURSDAY, NOVEMBER 10, 1904. JOHN TWEEDY, P.R.C.S., PRESIDENT, IN THE CHAIR.

Intraocular tumor completely enveloping the optic disc.

Mr. Simeon Snell (Sheffield) related this case, occurring in a farmer aged thirty-seven. He was first seen last February, and a month previously he had discovered loss of sight of the right eye. Vision equalled fingers indistinctly. An opaque mass covering the optic disc was discovered. It was more cyst-like, and appeared less solid than was noticed later on. The family history was good. After a few weeks the patient disappeared and was not seen again until the beginning of August, by which time the mass had become considerably larger and the appearance of solidity was much more noticeable. The mass was large and nodular and about 2½ disc diameters in size, somewhat circular in form, and completely hiding the optic disc from view. The most prominent part could just be seen with + 11 D, but there was an area close to this which could be best seen with + 6 D, and the macular region with + 2 D. A colored ophthalmoscopic drawing made at this time was shown. The diagnosis made was that of a tumor growing from the disc or in its immediate neighborhood. The eye was enucleated at the end of August and the nerve was removed as far back as possible. Close to the outer side of tbe nerve sheath was a small black nodule the size of a pin's-head. Mr. Treacher Collins examined the eyeball and reported that at the posterior pole was a melanotic growth. Its base was *7mm* in length, and extended from the choroid about the optic disc to a point a little lower than the centre of the disc.

Mr. Herbert Parsons read a paper on **some anomalous sarcomata of the choroid.** Six cases were demonstrated by means of lantern slides. Case 1 was an ordinary case of melanotic sarcoma of the choroid in the third stage, the extraocular portion being unpigmented; the patient died a year after the removal of the eye and was found to have secondary, bile-stained,

spindle-celled sarcoma of the liver, and squamous-celled carcinoma of the ribs, lung, and mediastinal glands. Cases 2 and 3 were almost identical in appearance and in general character. They contained very necrotic, round angiosarcomata of the choroid. There was extensive necrosis of most other structures in the eye. Case 4 had an extraordinary family and personal history: the mother and younger sister had each had an eye removed at Moorfields for sarcoma of the choroid, and the patient had had her breast removed for a tumor. There were two small melanotic sarcomata of the ciliary body and anterior part of the choroid, and a large bi-lobed, necrotic, angiosarcomatous mass springing from the choroid posteriorly. The other structures of the eye were necrotic, and there were many hemorrhages. Cases 5 and 6 were necrotic angiosarcomata springing from the choroid at the posterior pole of the eye. The other structures of the eye were also necrotic.

The points specially insisted on were as follows: The similarity of the growths macroscopically to organizing blood-clots, and their apparent origin in the retina — an appearance which was demonstrated to be erroneous; the varying occurrence of the hemorrhage, the importance of not overlooking sarcoma of the choroid in cases of severe intraocular hemorrhage (*cf.* Verhoeff), and the relation of the hemorrhage to the necrosis, whether a cause or a result, both probably occurring; the necrosis—its dissimilarity from the patches of necrosis in ordinary sarcomata, its universality, not only throughout the tumors but also in other parts of the eye. The deductions are: that the necrosis is not due to a preliminary iridocyclitis (*cf.* Leber and Krahnstöver), for there is little inflammatory reaction—infiltration—inside the eye; that it is not due to thrombosis, and only partially to hemorrhage, for the intraocular tumors are necrosed as a whole, and anastomosis in the eye is too free to permit of this result; that it is probably due to endogenous microbic infection, essentially by means of toxines universally distributed throughout the eye by the intraocular fluids—hence the comparative absence of leucocytes. Microbes are also probably present, finding a suitable nidus in the necrotic tissues, hence the slight amount of inflammatory reaction in the less severe cases. The theory is comparable with the most probable theory of sympathetic ophthalmia, viz.: generalized endogenous infection by (?) invisible organisms (*cf.* Römer). It explains the marked

inflammatory reactions sometimes seen outside the eye. The growths are probably of relatively low malignancy, on account of their genesis—peritheliomata,—their necrotic condition, and the thrombosis of the vessels. If, therefore, they were not excised, they would shrink and become examples of shrunken globes containing choroidal sarcomata. Further, they are an early stage of this small group, a stage which has not before been described. That the eyes would inevitably shrink is shown by the albuminous constitution of the intraocular fluids, which would lead to diminished filtration and stasis; moreover, the universal necrosis must lead to shrinkage. The growths are also identical in type with those previously found in shrunken globes (*cf.* Leber and Krahnstöver). Such tumors are probably frequently overlooked, owing to their great resemblance to blood-clots. They are of great importance practically from the point of view of prognosis, and especially theoretically, since they mark a stage which has previously escaped observation in the life history of a group of sarcomata.

SYSTEMATIC REPORT ON THE PROGRESS OF OPHTHALMOLOGY IN THE FOURTH QUARTER OF THE YEAR 1903.

By Dr. G. ABELSDORFF, in Berlin; Prof. ST. BERNHEIMER, in Innsbruck; Dr. O. BRECHT, Prof. R. GREEFF, Prof. C. HORSTMANN, and Dr. R. SCHWEIGGER, in Berlin; with the Assistance of Prof. A. ALLING, New Haven; Prof. E. BERGER, Paris; Prof. CIRINCIONE, Genoa; Dr. DALÉN, Stockholm; Prof. HIRSCHMANN, Charcow; Dr. J. JITTA, Amsterdam; Mr. C. DEVEREUX MARSHALL, London; Dr. H. MEYER, Brandenburg; Dr. P. VON MITTELSTÄDT, Metz; Dr. H. SCHULZ, Berlin; Prof. DA GAMA PINTO, Lisbon; and Others.

Translated by Dr. WARD A. HOLDEN.

Sections I.–III. Reviewed by PROF. C. HORSTMANN, Berlin.

I.—GENERAL OPHTHALMOLOGICAL LITERATURE.

434. **Landolt.** The methods of examination. *Graefe-Saemisch*, 2d edition, Leipsic: Engelmann, 1903.

435. **Groenouw** and **Uhthoff.** Relations of organic and general diseases to ocular changes and diseases. *Ibid.*

436. **Czermak.** *Eye Operations*, parts 13, 14, and 15. Vienna, Karl Gerald's Sohn, 1904.

437. **Oeller.** *Atlas of Rare Ophthalmoscopic Pictures*, Supplementary to the *Atlas of Ophthalmoscopy*, 3d part. Wiesbaden, J. F. Bergmann, 1904.

438. **Haab.** *Atlas of Ophthalmoscopy and Ophthalmoscopic Diagnosis*, 4th edition, Munich, Lehmann, 1903.

439. **Lagrange.** *Treatise on the Tumors of the Orbit*, vol. ii., Paris, 1904. Steinheil.

440. **Straub** (Amsterdam). *Handbook of Ophthalmological Examinations*, 2d edition, Amsterdam, 1903.

441. **Bruns.** Diseases of the eye in whites and negroes. *Trans. Amer. Ophth. Soc.*, 1903.

442. **Manche.** The first chair of ophthalmology. *La clinica oculista*, Sept., 1903.

443. **Leber.** The founding of the Heidelberg University eye clinic and its first directors. Heidelberg, 1903. C. Winter.

444. **Hirschberg.** On the most ancient Arabic text-book of ophthalmology. *Sitzungsber. d. Koenigl. Preuss. Akad. d. Wissenschaften*, Nov. 23, 1903.

445. **Pansier.** Congregatio sive liber de oculis. Paris, 1903. Baillière et fils.

446. **Pansier.** Epistola Jhesu filii Haly de cognitione infirmitatum oculorum sive memoriæ ocularіorum quod compilavit Ali Ben Issa. Paris, 1903. Baillière et fils.

447. **Risley.** Dr. William Fisher Norris. A memoir. *Trans. Amer. Ophth. Soc.*, 1903.

448. **Baily, W. O.** Causes of blindness in Kentucky. From a study of the eyes of the pupils of the Kentucky Institution for the Education of the Blind. *Amer. Pract. and News*, Dec. 15, 1902.

449. Report of the committee on standard test-types and on reading tests. *Trans. Amer. Ophth. Soc.*, 1903.

GROENOUW (435) in the new *Graefe-Saemisch* discusses the ocular affections found in many general diseases, while the chief part of the fascicles 68–71 is taken up with UHTHOFF'S exhaustive account of the eye symptoms in diseases of the nervous system.

The third fascicle of OELLER'S (437) atlas contains five well executed plates as follows: neuritis optica leucæmica, proliferatio pigmenti in regione maculæ luteæ post contusionem, corpus alienum in regione maculæ luteæ, dialysis retinæ sanata, and coloboma nervii optici et maculæ luteæ.

The second volume of LAGRANGE (439) *On the Tumors of the Eye* completes the work. It contains 360 pages with 218 figures in the text and 12 plates. It comprises an exhaustive clinical and pathological discussion of the tumors of the optic nerve, orbit, lachrymal apparatus, lids, and sinuses, well arranged and readable. GREEFF.

According to BRUNS (441) diseases of the lids among negroes are rare because of their lack of susceptibility to trachoma. Muscular anomalies are almost unknown and errors of refraction are infrequent. ALLING.

According to MANCHE the first cathedra of ophthalmology in any university was founded in Vienna in 1765 and was occupied by a Maltese, Dr. Josef Barth. CIRINCIONE.

According to LEBER (443), as early as 1818 Chelius gave instruction in ophthalmology in Heidelberg. The credit for founding an eye clinic belongs to Knapp, who in 1862 started a clinic for in- and out-patients in a large rented building with the help of a single state appropriation. In 1865, Knapp was made extraordinary professor and a chair was founded

for his specialty, and an annual state grant given to his clinic In 1868, Knapp resigned to take up his residence in New York. Otto Becker, his successor, was appointed regular professor. Through his efforts the new clinic, begun in April, 1878, was built. This building had 60 beds, and arrangements were made later for 85, with a large lecture room and operation room. After Becker's death in 1890 Leber obtained considerably more room by having an extension built with rooms for outpatients and a large laboratory.

HIRSCHBERG (444) writes of the most ancient Arabic text-book on ophthalmology by Humain, an excellent and learned physician who lived 808–873, principally in Bagdad.

PANSIER (446) writes of the works of the Arabian oculists, Alcoatin and Ali Ben Issa, who lived in the twelfth century.

BAILY (448) found the principal causes of blindness in 228 cases as follows: Purulent ophthalmia, 26.3 %. Trachoma, 14.5 %. Phlyctenular keratitis, 12.7 %. Congenital cataract, 10.5 %. Irido-cyclitis, 8.3 %. Atrophy optic nerve, 7.5 %. Traumatism and sympathetic ophthalmia, 6.6 %. ALLING.

The report (449) is in substance as follows: 1. The standard of Snellen of the visual angle of 5′ with the notation embodied in the formula V = d/D ought to be retained. 2. A graduation of the several sizes of test letters in geometrical progression, conserving as many as may be of the numbers included in the Snellen series, is to be preferred to the sequence of unequal ratios adopted by him. Two geometrical series based on the common ratio 1: $\sqrt{2}$ and 1: $\sqrt[3]{2}$ are recommended. 3. The simplified form of the capital letters known as "Gothic" is to be preferred to the black letters employed by Snellen. 4. For reading tests, ordinary print (Jaeger) should be used. 5. The standard in reading should be the ability to read print in which the height of the short "lower case" letters subtends a visual angle of 5′. For record, the notation of Snellen is slightly altered, L = d/D. L = reading power, d = greatest distance at which print is read, and D = distance at which it subtends standard angle of 5′.

ALLING.

II.—GENERAL PATHOLOGY, DIAGNOSIS, AND THERAPEUTICS.

450. **Lotin.** Ocular affection caused by the larvæ of flies. *Centralbl. f. prakt. Augenheilk.*, xxvii., pp. 328, 357.

451. **Basso.** A case of extraction of a splinter of iron from the vitreous of

the left eye ten months after its entrance. Traumatic reflex paralysis of the pupil and accommodation. *La clinica oculista*, March, 1903.

452. **Valenti.** Experimental investigations on the hemolytic power of the vitreous and aqueous humors. *Arch. di Ottalm.*, March, 1903.

453. **De Lapersonne.** Lymphocytosis of the cerebro-spinal fluid in ocular affections. *Bull. et mém. de la soc. franç. d'opht.*, 1903, p. 185.

454. **Boni.** On a case of acute poisoning with anilin oil. *Arch. di Ottalm.*, Feb., 1903.

455. **London, E.** The physiologico-pathological importance of the radium rays. *Arch. biol.*, x., 2.

456. **Spalding.** Tuberculosis of the eye. Two cases, one at the head of the optic nerve, the other at the equator. *Trans. Amer. Ophth. Soc.*, 1903.

457. **Darier.** On the treatment of the more serious syphilitic diseases of the eye. *The Ophthalmoscope*, Nov., 1903.

458. **Grossmann.** Coloboma cyst associated with microphthalmus. *Lancet*, May 2, 1903.

Lotin (450) observed in a child of three years a severe conjunctivitis of the right eye. Between the internal canthus and the lachrymal puncture there were several gray points so small as scarcely to be visible. These were removed with forceps and proved to be little spindle-shaped gray worms which lay in the tissues. After their removal the child soon recovered from the conjunctivitis. The worms proved to be the larvæ of a certain fly in the second stage of their development.

Basso (451), in a laborer eight months after the extraction of a splinter of iron from the vitreous of the left eye, found: V = $\frac{1}{6}$; concentric contraction of the field; complete paralysis of the sphincter of the iris and the muscle of accommodation; a dust-like opacity of the vitreous; and a small black foreign body in the region of the ora serrata encapsulated in a mass of white tissue. Two months later he found: pain; V = $\frac{1}{50}$; opacity of the vitreous. An incision was made through the sclera and a splinter of iron 17*mm* long was removed with the aid of Hirschberg's magnet. A month later: V = $\frac{1}{6}$; pupil medium-sized but not responsive; vitreous clearer. Cirincione.

Valenti (452) finds that the aqueous humor of animals whose serum is hemolytic has but slight hemolytic power. The vitreous humor possesses it in greater measure than the aqueous, but to a much less degree than the serum. Cirincione.

De Lapersonne (453) reports on further investigations in his clinic on lymphocytosis of the cerebro-spinal fluid in eye diseases. There were six cases of syphilitic optic neuritis and chorio-retini-

tis (three without lymphocytosis); nine cases of iritis (one without lymphocytosis); three cases of post-neuritic atrophy (without positive result); and one case, respectively, of meningeal affection with optic neuritis (positive), of brain tumor (negative), of ophthalmic migraine (negative), of oculomotor paralysis (positive). He believes that positive results justify the conclusion that the existing eye affection is of syphilitic nature. BERGER.

BONI (454) observed a case of acute poisoning in a dye-house worker who carelessly exposed himself to the vapor of anilin oil. He had vertigo, vomiting, headache, pallor, and fainting attacks. Recovery took place in fifteen days, but there remained almost complete temporal hemianopsia, with loss of perception of blue and green, blurred outlines of the disc, dilated veins, and empty arteries. These symptoms disappeared in two weeks.

CIRINCIONE.

According to LONDON (455), the radium rays cause light perception in the eye no matter what their direction. The rays are neither refracted nor reflected by the ocular media, but they are to a considerable extent absorbed. Continued or excessive action causes keratitis, retinitis, and the like. Covered eyes are after some practice able to follow the movements of the source of the rays and recognize simple figures described in space. When these rays fall on a platin-cyan screen they give rise to scattered light rays of particular wave length. This light may be perceived in quite dark rooms by portions of the retina retaining their function in cases of optic-nerve atrophy. Thus blind persons who still retain perception of light can obtain visual conceptions, and the author has taught blind persons the Russian alphabet on the light screen. HIRSCHMANN.

SPALDING (456) describes the case of a boy of eight who, after a fall, developed symptoms of meningitis with a yellow tumor in the interior of the right eye. Enucleation was followed by cessation of the constitutional symptoms. A tumor arising from the optic nerve was seen to fill one-third of the vitreous chamber and microscopical examination showed it to be tuberculous. Tubercle bacilli were found by staining. Granting a previous focus of infection, the injury may have initiated a tuberculous meningitis which travelled to the eye. Another case was of a boy seven years old who had lost one eye from ophthalmia neonatorum and had a dense leucoma covering the cornea. Owing to attacks of pain and tenderness, and because the other eye showed

signs of sympathetic irritation, it was enucleated. At the equator on the nasal side a small nodule was found encapsulated in a gelatinous membrane. Tubercle bacilli were found.

ALLING.

DARIER'S (457) paper was read at the annual meeting of the British Medical Association. In it the author describes some of the most serious syphilitic diseases of the eye, and shows, by cases of apparently the most hopeless nature, how much can be done by energetic and long-continued treatment with mercury, especially when given in the form of subconjunctival injections and also of intravenous injections. MARSHALL.

GROSSMANN'S (458) patient was a girl aged sixteen, who had a cyst the size of a pigeon's egg bulging into the left lower eyelid. The orbit was small and completely filled with the cyst. The right eye was smaller than normal and had a coloboma of the choroid. After removal a small rudimentary eye was found deep in the orbit. No connection could be found between the two.

The pathology of coloboma of the choroid is discussed, and in the five cases that had fallen under his observation no hereditary history was to be made out. MARSHALL.

III.—INSTRUMENTS AND REMEDIES.

459. **Margagni.** A new anæsthetic. *Ann. di Ottalm.*, 1903, p. 322.

460. **Lindenmeyer.** Eumydrin—a new mydriatic. *Berl. klin. Wochenschr.*, No. 47, 1903.

461. **Gradenigo.** On transfusion of the vitreous and a new instrument for this purpose. *Ann. di Ottalm.*, 1903.

462. **Dunring.** A new skiascope. *Sitzungsber. d. Niederl. Ophth. Soc.*, 1903.

463. **Stephenson, Sydney.** Tuberculosis of the conjunctiva cured by X-rays. *Brit. Med. Jour.*, June 6, 1903.

464. **Reid, A. D.**, and **Edmunds, Arthur.** A simple eyelid everter. *Lancet*, Aug. 15, 1903.

465. **Rodgers, W. G.** Case of acute poisoning after the instillation of small doses of atropine into the eye. *Glasgow Med. Journal*, Aug., 1903.

466. **Mayou, Stephen.** The X-ray treatment of trachoma. *The Ophthalmoscope*, Nov., 1903.

467. **Suker.** A new and simple demonstration ophthalmoscope. *Journ. Amer. Med. Assoc.*, Nov. 7, 1903.

468. **Bull, C. S.** The present status of subconjunctival injections in ophthalmic therapeutics. *Trans. Amer. Ophth. Soc.*, 1903.

469. **de Schweinitz.** Argyrosis of the conjunctiva and lachrymal sac, following the prolonged instillation of five-per-cent. solution of protargal. Microscopic examination of the excised sac. *Ibidem*, 1903.

LINDENMEYER (460) uses the new mydriatic eumydrin in 1–10 % solutions. Mydriasis occurs in ten to twenty-five minutes and the accommodation is paralyzed. The effect lasts three to five days. No evidences of intoxication were observed. The chief advantage of the drug is that it is far less poisonous than atropine.

GRADENIGO (461) constructed an instrument with which one can extract a considerable amount of the vitreous, and simultaneously replace it with the same quantity of water or of vitreous from an animal. The instrument consists of two small pumps—one for aspiration and one for pressure, which act alternately and are provided with two curved hollow needles which are passed into the eye at the equator. CIRINCIONE.

DUNRING (462) demonstrated a new skiascope of small size and easy to use. A Rekoss disc is employed containing a large number of lenses. JITTA.

STEPHENSON'S (463) is the first case of the kind on record that has been cured by X-rays. The child was four years of age, and had tuberculous deposits in the lower palpebral conjunctiva, and also in the upper retrotarsal folds. The neighboring lymphatics were also much affected. Tuberculous tissue was demonstrated in the conjunctiva as well as tubercle bacilli. Inoculation experiments produced a positive result.

The affected eye was treated with the X-rays on thirteen occasions of about ten minutes each. The case was cured without any visible cicatrization of the conjunctiva. Tubercle bacilli were also found in cover-glass preparations made from a gland removed from the patient's neck. MARSHALL.

In order to avoid the exposure of the surgeon's fingers during the treatment of eyelids with X-rays, REID and EDMUNDS (464) have devised a simple appliance, which consists of a special pair of forceps, by means of which the lids can be everted and held in position with tapes. This should prove useful to those engaged in treating their patients in this manner. MARSHALL.

RODGERS'S patient was a man, aged seventy-three, who had had a cataract removed. Four days later it was dressed for the first time, and two drops of a two-per-cent solution of atropine were instilled into the eye. Twenty minutes later, there was low muttering delirium, and shortly afterwards the patient became violent, the face was very flushed, the throat dry, pulse and respiration

rapid. Nepenthe 15*m* with ½ oz. of whiskey were given, and later on ¼ grain of morphia was injected. Both pupils were widely dilated, and the respiration assumed the Cheyne-Stokes character. He rapidly recovered and was quite well the next day. MARSHALL.

MAYOU (466) has given the X-ray treatment extensive trials in cases of trachoma, and as the result he is very favorably impressed with its utility. He describes in this paper his method of applying the rays, and concludes that the chief points in its favor are:

1. It is painless.

2. There is considerably less deformity of the lid after treatment.

3. The pannus clears more thoroughly.

MARSHALL

SUKER (467) has devised a stationary ophthalmoscope which allows three students, in addition to the instructor, to view the fundus at the same time. The indirect method is employed. Plane lenses placed obliquely in a tube reflect the rays to each observer. ALLING.

BULL (468), after a careful review of the literature and the study of his own cases, concludes that subconjunctival injections do not bring about any more rapid or favorable results than other methods of treatment employed for affections of the cornea, uveal tract, or retina. He believes that favorable reports should be thoroughly proven before acceptance.

ALLING.

DE SCHWEINITZ (469) found the pigment deposited in the submucous tisssue, and not in the epithelium. The protargol had been used about three or four months.

ALLING.

Sections IV–VII. Reviewed by DR. G. ABELSDORFF, Berlin.

IV.—ANATOMY.

470. **Halben.** Contributions to the anatomy of the tear passages. *Graefe's Archiv*, lvii., p. 61.

471. **Cirincione.** On the origin of the vitreous in vertebrates. *La clinica oculista*, July, 1903, p. 1353.

472. **Gutmann.** On the collagenous and protoplasmic tissue of the iris. *Zeitschr. f. Augenheilk.*, p. 8.

473. **van Gehuchten.** The actual origin and the intra-cerebral course of

the motor nerves, as shown by the method of indirect Wallerian degeneration. *Arch. de neurologie*, 1903, p. 333.

474. **Rochon-Duvigneaud.** A note on the anatomy of the orbit as seen in total microscopical sections after decalcification. *Arch. d' opht.*, xxiii., 12, p. 769.

475. **Verhoeff.** A hitherto undescribed membrane of the eye, and its significance. *Boston Med. and Surg. Journ.*, Oct. 22, 1903.

HALBEN (470) finds the nasal duct surrounded by a dense mat of elastic fibres, which extend out among the longitudinal muscle-fibres surrounding the canaliculi. This elastic tissue explains the extent to which the lachrymal passages can be dilated. The mouth of the canaliculus is surrounded by muscle fibres arranged in sphincter form. The nasal duct, which has a laminated pavement-epithelium, lacks a submucosa, while the wall of the sac, containing adenoid tissue, has a many-layered cyclindrical epithelium.

CIRINCIONE (471) refers, in a preliminary notice of his work begun in 1892, to the different views in respect to the origin and development of the vitreous. He maintains that a judgment in regard to the matter after the examination of a few imperfect preparations is likely to be erroneous, and in order to arrive at the truth one must, as he has been doing, make exhaustive researches with preparations from all species and genera of vertebrates, employing all known methods of technique. He has used the newest and most valuable method of Gieson (van Giesen, TRANS.), and comes to the conclusion that there is an embryonic vitreous proceeding from the retina, which he calls the filling substance, and a fœtal vitreous which replaces the other. In the fœtal vitreous he distinguishes the stroma of mesodermic origin, and the liquid portion coming from the non-visive portion of the retina. CIRINCIONE.

GUTMANN (472) finds that in the new-born the collagenous framework of the iris is present as in adults, but the meshwork is characterized by the delicacy of the individual fibres, while in adults the fibres are increased in size and number, and are arranged concentrically about the vessels. This increasing density of the meshwork, and the formation of a connective-tissue mantle about the vessels, are most marked in the irides of the aged. Possibly the increase in connective tissue in old age accounts in part for the greater resistance of the iris and its weaker reaction to atropine.

VAN GEHUCHTEN (473) has used a new method to study the nuclei of motor nerves. After tearing off a motor nerve, the root fibres and their cells of origin in the nucleus degenerate in from twenty-five to thirty-five days. He studied in this way the nuclei of the third, fourth, and sixth nerves in the rabbit. In the third nerve the proximal fibres are uncrossed, the distal partly crossed. Of the latter, the crossed came from the dorsal portion of the nucleus, and the uncrossed fibres from the ventral. No third-nerve fibres come from the corpora quadrigemina (Majana) or from the nucleus of the sixth (Duval and Laborde). The greater portion of the fibres of the fourth nerve arise in the nucleus of the opposite side, only a small portion being crossed. The crossing takes place in the valve of Vieussens. The sixth-nerve fibres are all uncrossed, and arise in part in a group of ganglion cells lying dorsally and commonly described as the nucleus of the sixth, and in part also in a ventrally lying nucleus (accessory or van Gehuchten's nucleus), which Baedecker and Siemerling wrongly consider a portion of the nucleus of the seventh. BERGER.

ROCHON-DUVIGNEAUD (474) recommends for studying the topographical relations of the contents of the orbit frontal sections through the orbit. The entire orbit is fixed, decalcified, and dehydrated. His four plates of frontal sections at different depths give most accurately the true relations of the parts, yet they are not more complicated than the ordinary diagrammatic representations. In the new-born, the eye and the muscles occupy a relatively greater portion of the orbit than in the adult. The topography of the upper-outer portion of the orbit particularly is not well understood. v. MITTELSTÄDT.

VERHOEFF (475) claims to have discovered a fenestrated membrane in the pigment layer of the retina identical in structure and staining reactions with the membrana limitans externa. It appears as a delicate line running along near the inner margins of the pigment cells, which project beyond it to a varying degree. ALLING.

V.—PHYSIOLOGY.

476. **Bernheimer.** The cerebral tracts for the movements of the eyes. *Graefe's Archiv*, lvii., p. 1.

477. **London.** The relation of radium rays to vision. *Ibid.*, p. 342.

478. **Roselli.** Daltonism in children. *Ann. di Ottalm.*, 1903.

479. **Ovio.** On the field of vision. A contribution to the physiology of the eye. *Arch. di Ottalm.*, p. 181, 1903.

480. **Sterling.** Cerebral cortex and eye movements. *Arch. f. Anatom. u. Physiol.*, Physiol. Abtheil., p. 487, 1903.

481. **Shinkicki Imamura.** On cortical disturbances of the visual act and the function of the posterior commissure. *Pflueger's Arch. f. d. ges. Physiol.*, 100, p. 495.

482. **Huggard.** Ocular accommodation and the apparent size of objects. *Brit. Med. Journ.*, Sept. 12, 1903.

483. **Anderson, H. K.** Reflex pupil dilatation by way of the cervical sympathetic. *Journ. of Physiol.*, vol. 30, No. 1.

484. **Black.** The development of the fusion centre in the treatment of strabismus. *Journ. Amer. Med. Assoc.*, Oct. 10, 1903.

BERNHEIMER'S (476) experiments on monkeys revealed the pathway leading from the angular gyrus as the cortical centre of synergetic eye movements to the nuclei of the oculomotor muscles. Extirpation of the left angular gyrus caused for about a week a paralysis of dextroversion, which later could no longer be made out. The anatomical examination of the degenerated fibres showed that the angular gyrus of each side is in connection with the ocular nuclei of the opposite side, the terminal portions of the tracts of fibres entering chiefly the ventral part of the longitudinal bundle and in part through this medium communicating with the ganglion cells of the nuclei of the ocular muscles.

The gradual recovery from the defective mobility following the operation is due to the fact that impulses to movement proceed from neighboring cortical parts of the occipital lobe, which also send fibres through the longitudinal bundle to the nuclei of the ocular muscles.

LONDON'S (477) investigations on the perception of light educed by the radium rays show that perception occurs in the dark-adapted eye only, and hence the fluorescence phenomena are perceived better by the periphery than by the centre of the retina.

On comparing aphakic with sound eyes, the perception of light was found to be more marked in the former, indicating that the lens absorbed the radium rays.

After several hours' action of the rays on rabbits, an opacity of the cornea and inflammation of the retina were noticed three weeks later.

Dark stripes and figures on a fluorescent radium screen were

perceived by the blind who still had perception of light, and this may prove to be a useful means in teaching the blind in asylums.

ROSELLI (478) from the examination of one hundred children who seemed to be affected with Daltonism, but after training with different colors came to recognize them all, concluded that in children true dischromatopsia does not exist, but only achromatopsia as the result of imperfect training.

CIRINCIONE.

OVIO (479) after numerous observations comes to the following conclusions:

1. In the ordinary visual act the movements of the eyes are almost always combined with movements of the head.

2. The movements of the eyes are usually limited to excursions of about 30°. CIRINCIONE.

According to STERLING (480), who worked with dogs in H. Munk's laboratory, the eye movements following irritation of the occipital cortex are to be considered only as associated movements in connection with those of the head, while the primary centre for eye movements, "in all probability," lies in the facialis region of the cortex.

IMAMURA (481), experimenting under Exner, concluded that in dogs the entire cortex of the upper convexity of the cerebrum is used in the act of vision, and that disturbances caused by lesions here mostly pass off—other parts assuming the function. Only injuries of the occipital portion of the cerebrum and the posterior portion of the parietal region cause permanent disturbances of vision, since the fibres of the optic radiations end there. There are doubtless many amblyopias which cannot be studied in animals. These visual disturbances are recovered from in part by the other hemisphere taking up the function through the medium of the posterior commissure.

HUGGARD (482) points out that one can at will alter the apparent size of objects by a voluntary change of accommodation. By fixing the eye on a distant object and shutting one eye and then accommodating for near vision, the distant object at once appears to become smaller. MARSHALL.

ANDERSON (483) first goes into the results obtained by previous observers and throws considerable doubt on the occurrence of contraction of the pupil after division of the third nerve. To

settle this he made five experiments on anæsthetized cats. He first of all divided the third nerve or else excised the ciliary ganglion. In each, after section, marked dilatation was obtained by the stimulation of various nerves such as the sciatic. There was also movement of the nictitating membrane, the lids were separated, and the eyeball was more or less protruded. None of these results occurred after section of the cervical sympathetic. He found that, after section of the sympathetic, light had no effect on the pupil. After section of the 3d nerve, hippus may occur, and this rhythm at once ceases on section of the cervical sympathetic. After section of the spinal cord below the bulb, stimulation of the central end of the sympathetic still causes slight pupil dilatation, reaction of the nictitating membrane, and separation of the eyelids. MARSHALL.

BLACK (484) uses a modification of the amblyoscope of Worth. The attempt is first made to improve the vision of the squinting eye by exclusion of the other. Exercise is then kept up with the amblyoscope. He records highly satisfactory results.

ALLING.

VI—REFRACTION AND ACCOMMODATION.

485. **Heine.** Clinical and theoretical observations on the myopia question. *Arch. f. Augenheilk.*, xlix., p. 14.

486. **Tscherning.** The mechanism of accommodation. *La clinica oculista*, Nov., 1903, p. 1481.

HEINE (485) believes that accommodation is of no significance in the increase of myopia, but rather an hereditary lessened resistance of the sclera and increase of intraocular tension by abnormal contraction of the extrinsic muscles. In the latter respect a full correction is desirable and bad results have not been seen to follow. His conclusions after going over the literature are that full correction acts rather more favorably as regards the progression of the myopia.

TSCHERNING (486) in his paper collects all of his own important observations as well as those of his pupils.

He maintains that the mechanism of accommodation is as follows: Traction of the zonula on the equator of the lens; formation of an anterior lenticonus. He also describes various phenomena that occur in accommodation, such as sinking of the lens through its own weight, tremulousness, and the like, which he attributes to a dense, free, central crystalline mass in the capsule.

CIRINCIONE.

VII.—MUSCLES AND NERVES.

487. **Levinsohn.** On the condition of the muscles of the iris in traumatic paralysis of the pupil. *Klin. Monatsbl. f. Augenheilk.*, xli., 2, p. 515.

488. **Marina** and **Cofler.** On the contraction of the sphincter iridis and on convergence and lateral movements of the eyes. *Deutsche Zeitschr. f. Nervenheilk.*, 24, p. 274.

489. **Berger** and **Loewy.** On the secondary contraction of the elevator muscle of the upper lid in the course of facial paralysis. *Revue neurologique*, Dec. 15, 1903.

490. **Trombetta** and **Ortino.** New investigations on the genesis of nystagmus. XVI. Italian Congress of Ophth., *Ann. di Ottalm.*, 1903.

491. **Sym, W. G.** A case of recurrent paralysis of the third nerve. *Ophth. Review*, Nov., 1903.

492. **Donaldson, E.** Strabismus fixus. *The Ophthalmoscope*, Nov., 1903.

493. **Story, J. B.** Strabismus convergens and its treatment. *Med. Press and Circular*, July 8, 1903.

494. **Gleason, J. E.** Idiopathic myositis involving the extraocular muscles. *Ophth. Record*, Oct., 1903.

495. **Duane.** The value of the screen test as a precise means of measuring squint. *Annals of Ophth.*, Oct., 1903.

Levinsohn (487) reports two cases of traumatic mydriasis in which, besides the paralysis of the sphincter, there was revealed a paresis of the dilatator by the fact that when shaded this pupil, which had been wider, became narrower. A further observation of the traumatic myosis in a non-irritated eye (with no reflex contraction of the sphincter from irritation of the trigeminus) revealed the picture of a pronounced paralysis of the dilatator. As this passed off, evidences of paralysis of the sphincter appeared in that the pupil, which had been narrower than that of the uninjured eye, now became wider.

Marina and Cofler (488) excluded the internal rectus in order to test the independence of the pupillary reaction from innervation of the convergence centre. In monkeys they grafted the superior oblique on the tendon of the divided internal rectus, or they transplanted the internal rectus to the site of the external. After complete healing, the movements of the eyes were normal again, and when the eyes were in a position of convergence the pupils contracted. The experiments proved that "the reaction in convergence is a phenomenon not concomitantly connected with innervation of the centres for the internal recti nor of the centre for convergence."

The transplantation experiments show also that convergence may take place even when both internal recti are excluded—for

example, with one superior oblique and external rectus; further, that lateral movements of the balls may take place through the action of both external recti or of one external rectus and superior oblique. Hence "the supposition that there is a subcortical centre of convergence, as well as a centre for lateral movements of the eyes, seems at least superfluous."

BERGER and LOEWY (489), who previously wrote of secondary contraction of the elevator of the upper lid in the course of facial paralysis, now having observed three further cases, give a detailed clinical description of the condition. When this contracture exists, the margin of the upper lid is higher than that on the other side, while when no contracture exists in cases of facial paralysis it is lower. This contracture may cause the condition of lagophthalmus to continue and favor the development of necrotic keratitis. In one case, the writers were for this reason forced to do a blepharorrhaphy. The duration of the facial paralysis rather than the site of the lesion affects the secondary contracture. BERGER.

The experimental and clinical investigations of TROMBETTA and ORTINO (490) prove a connection between ocular movements and the vestibular nerve. Nystagmus is a disturbance of innervation of the eye muscles caused by an anomalous reflex irritation of the ampullæ of the semicircular canals. According to the writers, nystagmus is a condition of irritation anomalous to giddiness. CIRINCIONE.

The patient described by SYM (491) was a woman, aged thirty-six, who was strong and healthy. During her first three pregnancies there was no complaint of her vision. During the last month of her fourth pregnancy the sight was dim, and for the last two weeks she had diplopia. In less than a week after her confinement this all passed off and did not return until six weeks before her fifth confinement, when she again got diplopia with some ptosis. She recovered from this shortly after delivery and remained well until within nine or ten weeks before the termination of her sixth pregnancy, when the same symptoms reappeared. When examined, the pupil and accommodation of the affected eye were paralyzed, as well as the other muscles supplied by the third nerve. The author has had the patient under observation for more than two years, and in spite of treatment only partial recovery has taken place. The author considers that the lesion here is basal and probably inflammatory in nature, determined

by certain of the toxines present in the system during pregnancy. Each recurring attack renders the part more susceptible to the same injurious influences, and makes the recovery more protracted and imperfect. In a number of reported cases there have been some errors of menstruation, and here we have an example occurring during physiological amenorrhœa.

MARSHALL.

After mentioning the view of von Graefe, that the cause of the condition was due to the attachment of the eyeball to the orbital wall, DONALDSON (492) mentions the tendency that this condition has to become greater as time goes on. Post-mortem examination is needed to determine the exact condition present in these cases. He then described the case of a woman aged fifty who came under his observation. An attempt was made to rotate the eyeball forcibly outwards, but this was found impossible. He did not divide the internal rectus and its attachments as in these cases he does not consider this practice of the slightest value. MARSHALL.

STORY (493) commences this paper by giving an account of the causation of convergent squint according to different observers. He then gives the points that should be investigated in any case of squint, and then considers the treatment under the three heads of (1) optical, (2) operative, (3) orthoptic. He insists on the fact that no infant is too young to be treated for this condition, inasmuch as it is only in the first years of life that one can hope to develop the fusion faculty. Three cases illustrating the value of orthoptic and optical treatment are described.

MARSHALL.

Primary idiopathic inflammation of muscles is of extremely rare occurrence. According to GLEASON (494), only one case involving the orbital muscles has been previously reported. His patient, a man of fifty-nine, came with distinct exophthalmus of the right eye, chemosis, and hazy cornea. A hard mass could be felt in the upper part of the orbit. Enucleation was performed on account of impending panophthalmitis. The superior rectus was found enormously enlarged. There was no orbital cellulitis. The microscope showed interstitial myositis. Two months later he was attacked in a similar way in the other eye, which was also removed. Here all the extraocular muscles were involved. ALLING.

DUANE (495) employs the screen test (observing the movement of each eye when alternately covered) with the addition of a prism. The angle of deviation of a prism which abolishes the movement will measure within two degrees the amount of heterophoria or squint. ALLING.

Sections VIII.–XII. Reviewed by DR. R. SCHWEIGGER, Berlin.

VIII.—LIDS.

496. **Rollet.** Blepharoplasty with double pedunculated flaps. *Rev. génér. d'opht.*, xxii., p. 481.

497. **Abelsdorff.** The mechanical treatment of blepharoptosis. *Deutsche med. Wochenschr.*, 1903, No. 35.

498. **Cohn, Paul.** Total anchyloblepharon from pemphigus ending in complete recovery. *Zeitschr. f. Augenheilk.*, x., 5, p. 421.

499. **Knapp, H.** On hypertrophy and degeneration of the Meibomian glands. *Trans. Amer. Ophth. Soc.*, 1903.

500. **Dodd.** Skin-grafting for the restoration of the eyelids. *Jour. Amer. Med. Assoc.*, Oct. 17, 1903.

501. **Marple.** A case of traumatic ptosis operated upon with most satisfactory result according to the method of Dr. Gruening or Gillet de Grandmont. *Trans. Amer. Ophth. Soc.* and *Ophth Record*, Oct., 1903.

502. **Alleman.** An unusual case of ptosis. *Ophth. Record*, Oct., 1903.

ROLLET (496) recommends, when there has been considerable loss of substance in the lids, performing blepharoplasty by means of a nasal and a temporal crescentic flap, which are brought together in the form of a Z. The cosmetic result in three cases in which the operation was employed was very satisfactory. BERGER.

ABELSDORFF (497) calls attention again to Meyer's support for sunken upper lids, which is inserted in the folds of the upper and lower lids like a monocle, yet has sufficient spring not to interfere with the closure of the lid. When spectacles or pince-nez are worn, the support may be attached to them.

In a child described by COHN (498), the lid margins were united, but the eyeballs were freely movable behind them, there being no symblepharon, although the palpebral conjunctiva, after the operation, showed dirty grayish-red ulcers. In a week the cut had healed well.

Two years ago, KNAPP (499) reported in the *Trans. Amer. Ophth. Soc.*, vol. ix., a case of degeneration of the

Meibomian glands, upon which he had operated several times, but which had recurred. He was obliged later to perform enucleation and exenteration of the whole orbit, leaving only the nasal two-thirds of the lower lid. There was after that no sign of the disease for a little over a year, when a globular mass, about one inch in diameter, appeared at the upper edge of the orbit. This was removed, and no recurrence had taken place at the time of the last observation three months later. Another case of adeno-carcinoma, originating in the Meibomian glands of the upper lid, occurred in a child of three and a half. It had been growing for about a year. The tumor was excised, and seven months later there was no evidence of recurrence. Mention is also made in this paper of a similar case of carcinoma showing glandular structure, upon which exenteration was performed by Dr. J. M. Mills. The glands before the ear and the neck were affected and removed at the Roosevelt Hospital (see Dr. Mills's paper in these ARCHIVES, xxxiii., No. 5, Sept., 1904).

ALLING.

DODD (500), after reporting three cases of skin-grafting, concludes that Thiersch grafts should always be used for the upper lid unless the whole thickness has been destroyed. In the lower lid the adjacent skin may be used to form the graft and the resulting defect covered with Thiersch graft, but when there is dense cicatricial tissue for the floor a flap with pedicle is to be preferred. ALLING.

ALLEMAN (502) reports a case of traumatic prolapse of the skin of the upper lid simulating ptosis. ALLING.

IX.—LACHRYMAL APPARATUS.

503. **Santucci.** On traumatic luxation of the lachrymal gland. *Ann. di Ottalm.*, 1903, p. 827.

504. **Poulard.** Tuberculosis of the lachrymal passages. *Arch. d'opht.*, xxiii., 12, p. 773.

505. **Elliot.** Some modern opinions on the treatment of inflammation and stricture of the lachrymal passages. *The Ophthalmoscope*, Oct., 1903.

506. **Snydacker.** Radical cure of blennorrhœa of the lachrymal sac. *Chicago Med. Recorder*, Oct. 15, 1903.

SANTUCCI (503) found in a girl of twelve a hard, immovable non-painful tumor, as large as a hazel-nut, in the outer portion of the upper lid. It had appeared seven years before, after the girl had struck against a branch of a tree, and it had remained

stationary. When removed, it was found to be a luxated lachrymal gland, with slight leucocytic infiltration and hyperplasia of the interstitial connective tissue. CIRINCIONE.

POULARD (504) describes three forms of tuberculosis of the lachrymal sac. In the first, after epiphora, an acute dacryocystitis develops, with rupture and the formation of a fistula. The lymphatic glands of the same side of the face swell and often suppurate. Recovery follows curettage and thermo-cauterization of the sac.

The second sort is slower in its development and the glands swell moderately and do not suppurate. Here, as in the first sort, there is tuberculosis of the neighboring cavities.

The third sort is still slower and the glands do not enlarge. Lupus of the nose and mouth is always to be sought for.

v. MITTELSTÄDT.

In this interesting paper ELLIOT (505) gives the experience he has gained when travelling among the various clinics of Europe.

He describes the different methods adopted for the cure of the condition, and also for the treatment of the infected corneal ulcers that so frequently are the result. MARSHALL.

SNYDACKER (506) excises the lachrymal sac by making an incision anterior to the crest of the lachrymal bone, and raising the periosteum behind the sac with an elevator. The whole sac with the underlying periosteum is then dissected out. ALLING.

X.—ORBIT AND NEIGHBORING CAVITIES.

507. **v. Ammon.** On periostitis and osteomyelitis of the roof of the orbit. *Arch. f. Augenheilk.*, lxix., 1, p. 1.

508. **Lagrange.** Diagnosis and treatment of tumors of the orbit. *Bull. et mém. de la soc. franç. d'opht.*, 1903, p. 1.

509. **Cirincione** and **Calderaro.** Bilateral chloroma of the orbits. *La clinica oculista*, Sept.-Nov., 1903.

510. **Browne.** A case of enchondroma of the orbit. *Bull. et mém. de la soc. franç. d'opht.*, 1903, p. 103.

511. **Bertram.** On exophthalmus. *Klin. Monatsbl. f. Augenheilk.*, xli., II, p. 294.

512. **Bull, C. S.** A case of pulsating exophthalmus of traumatic origin. Ligation of the common carotid artery. Recovery, *Trans. Amer. Ophth. Soc.*, 1903.

513. **Chance, B.** Orbital cellulitis as a sequel of scarlatina. The report of two cases. *Proceed. Phil. County Med. Soc.*, May 30, 1903; also *Amer. Med.*, June 13, 1903.

According to v. AMMON (507), if orbital phlegmons are treated with warm fomentations and in an expectant manner there is danger that the underlying affection of the bone will be overlooked. The orbital affection was cured by the warmth in one of his cases, but a focus developed in the bone which did not involve the palpable portions of the periosteum, and two months after apparent recovery the patient died of abscess of the brain. He advises, therefore, in suspicious cases, instead of simple incision into the orbital tissues, an extensive elevation of the periosteum of the roof of the orbit. A case so treated soon resulted favorably.

CIRINCIONE and CALDERARO (509) call attention to the rarity of chloroma and its constant location in the orbit, and after giving a résumé of the literature report a case of their own with autopsy. A rapidly progressive exophthalmus appeared on the left side in a girl of fifteen. A non-sensitive, hard mass could be felt behind the ball. A similar condition developed on the right side, after which fever began and the patient soon died.

At the autopsy, greenish plaques were found on each side in the petrosal sinus and the meninges of the upper part of the brain.

The periosteum of the roof of the orbit was thickened to $\frac{1}{2}cm$, and of a greenish color. Similar greenish plaques were found on the sternum and the pelvis, and abscesses were found in the elbow and gluteal regions. The tumor histologically belonged to the fibrosarcomas with marked endothelial proliferation. The green color could be removed by leaving a piece of the tumor in water, chloroform, alcohol, or any acid solution. Many tests showed that in this case the color was not derived from the blood. The presence of numerous groups of streptococci in the tumors led the writers to believe that the pigmentation might be due to micro-organisms circulating in the tissues and coming in contact with the liquids of the tumors. At any rate chloroma deserves no special place in onkology since its coloring is accidental and in no way dependent upon a particular histological structure.

CIRINCIONE.

BROWNE (510) observed in a woman of fifty-six an enchondroma of the orbit springing from the inner-lower wall and extending into the antrum of Highmore. The tumor was removed with good cosmetic result.

BERGER.

In BERTRAM'S (511) first case a purulent inflammation of the antrum of Highmore broke through the bony floor of the orbit and set up an inflammation in the retrobulbar tissues. After an incision at the infraorbital margin pus escaped and there was quick recovery.

In his second case there was a soft tumor which could be pressed into or out of the orbit. Accompanying this were flat tumors on the forehead and temple which bled when incised. The autopsy revealed a soft tumor—a fungus of the dura mater—occupying the entire left anterior quadrant of the cranium, which might have been removed in the beginning.

XI.—CONJUNCTIVA.

514. **Gasparrini.** Acute, bilateral, symmetrical inflammation of Krause's glands. *La clinica oculista*, March, 1903.

515. **Magnani.** Excision of the tarsus in the treatment of spring catarrh. *Ibid.*, Oct., 1903.

516. **Haupt.** On gonorrhoic and non-gonorrhoic conjunctival inflammation in the new-born, *Klin. Monatsbl. f. Augenheilk.*, xli., 2, p. 447.

517. **Müller, L.** The etiology of trachoma. *Graefe's Archiv*, lvii., 2, p. 138.

518. **Cirincione.** Hereditary late gumma of the conjunctiva. *La clinica oculista*, May, 1903.

519. **Collomb.** A contribution to the study of malignant epibulbar tumors (carcinomas and angiopapillomas of the limbus). *Bull. et mém. de la soc. franç. d'ophtal.*, 1903, No. 19.

520. **de Schweinitz** and **Shumway.** A note on the histology of vernal conjunctivitis. *Univ. Penn. Med. Bull.*, June, 1903.

521. **Jackson, Edw.** Tuberculosis of the conjunctiva. *Trans. Amer. Ophth. Soc.*; also *Ophth. Record*, Oct., 1903.

522. **Allport.** A case of vernal conjunctivitis. *Ophth. Record*, Oct., 1903.

GASPARRINI'S (514) patient, a man of thirty, developed a swelling of the outer half of each upper lid accompanied by sharp pain. Soon he had a chill and a rise in temperature, and œdema of the lids and chemosis of the conjunctiva. Under the influence of hot fomentations and diaphoretics, the condition improved so that after five days one could feel a small tumor in the outer third of the upper margin of the tarsus. Puncture allowed the escape of sanguino-purulent liquid, in which the pneumococcus was found. The author believes that he had to do with an inflammation of the glands of Krause and refers to a similar report by Calderaro. CIRINCIONE.

In a case of obstinate recurrent spring catarrh MAGNANI (515) removed the portion of the upper tarsus in which the disease was especially well marked. The results were satisfactory. The excised portion of the tarsus was replaced by a previously prepared flap of muscle and mucosa. CIRINCIONE.

HAUPT (516), in 62 cases of suppuration in the new-born, found 17 in which the gonococcus was not found. Five of these were severe, eight mild, and four simple catarrhs. One case in which the colon bacillus was present ran the course of a severe blennorrhœa, two with influenza bacilli ran the course of a severe catarrh, while a streptococcus case resembled a severe catarrh without symptoms of blennorrhœa.

MÜLLER (517), after studies in Egypt and after following a small epidemic in Graz, feels surer that the bacillus he described some years ago is the actual cause of trachoma, and that it really differs from the influenza bacillus, which some have doubted.

CIRINCIONE's (518) case is the first reported of hereditary late syphilis of the conjunctiva. He found a fleshy, painless, gelatinous, copper-colored elevation of the conjunctiva near the outer canthus. There were no evidences of actual syphilis. There was a family history of syphilis and tuberculosis. The patient was anæmic and lymphatic.

The clinical diagnosis of gumma was confirmed by microscopic examination and the brilliant result of treatment with iodides and tonics. CIRINCIONE.

COLLOMB (519) reports three cases of malignant epibulbar tumor. In Case 1, an epibulbar carcinoma was extirpated without recurrence in three years. In Case 2, a large epibulbar carcinoma was extirpated with the eyeball, and tumors were found in the iris and ciliary body. In Case 3, an angiopapilloma of the limbus was extirpated and recurred 18 months later.

The specimen examined by DE SCHWEINITZ and SHUMWAY (520) was part of the growth on the tarsal cartilage in a case of vernal conjunctivitis. It was covered by from ten to sixteen layers of squamous epithelial cells where normally the conjunctiva has two layers of cylindrical cells. The principal mass of the growth was found to be fibrous-connective tissue, and was divided into lobules by partitions lined with cylindrical epithelium. There were also numerous processes of epithelial cell formation which dipped downward from the surface. In some places these

masses of cells had undergone degeneration, with the production of spaces. There was also some round-cell infiltration to be seen. The results agree with the descriptions of former writers.

JACKSON (521) presents a case of tuberculosis of the conjunctiva, with a reproduction of water-color sketches. A girl of ten came with the history of swelling of the left eye, cheek, and neck, accompanied by increased temperature and vomiting. The conjunctiva of the upper lid was hyperæmic and thickened with numerous small granulations. On the lower lid the thickening was greater, and near the margin there were large trachoma-like granules. In the fornix there was much, apparently fatty, necrosed tissue. A moderate discharge was present, in which tubercle bacilli were repeatedly found. The condition three months later was somewhat improved. ALLING.

ALLPORT (522) describes a case of vernal conjunctivitis of the palpebral form which received eighty daily treatments by exposure of the granulations to the X-rays. The patient was free from annoying symptoms during the treatment, which was carried on in the summer, and smooth cicatrices were left in place of the granulations. The author considers this a satisfactory condition and believes it to be a permanent cure.

ALLING.

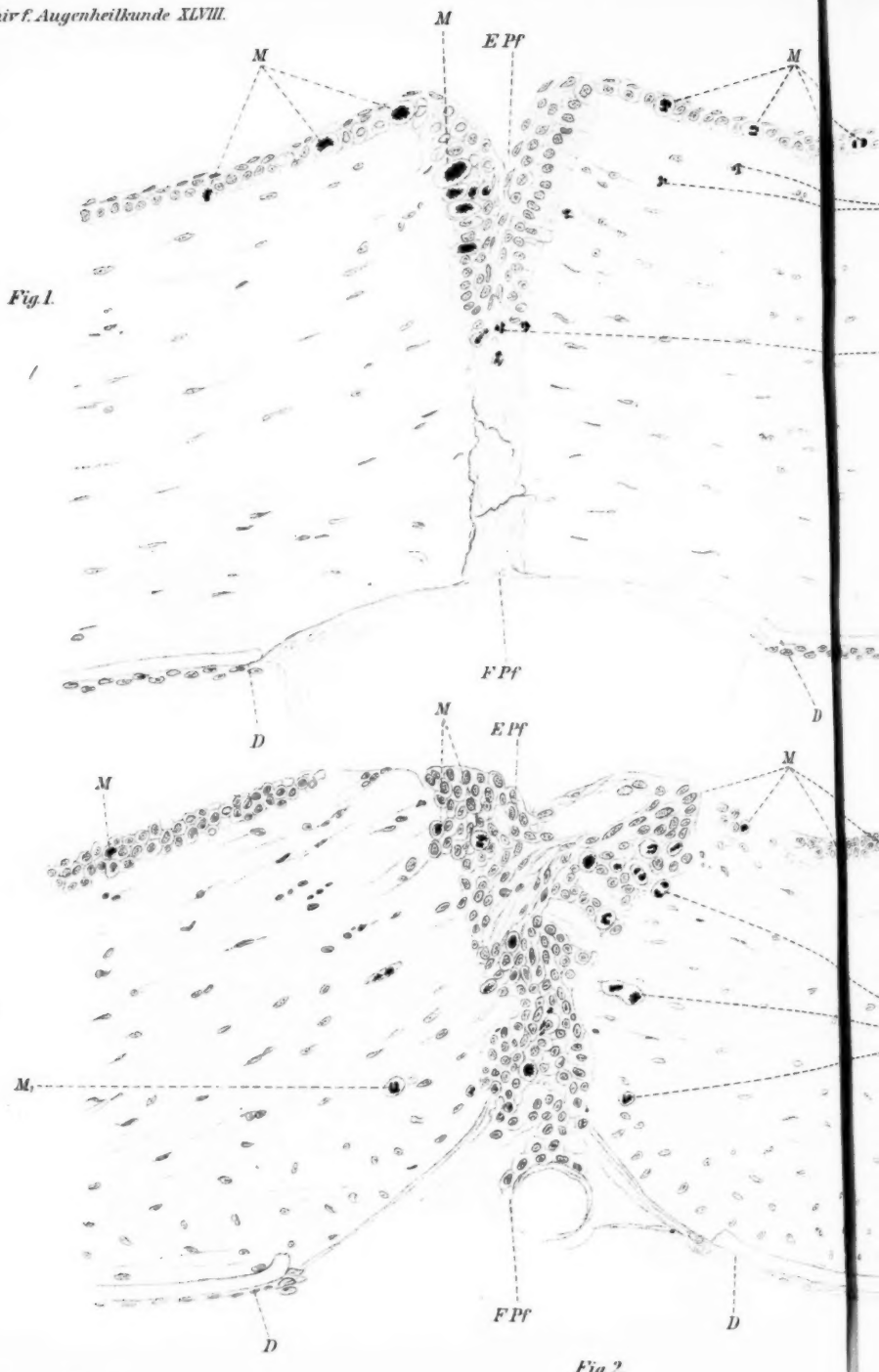

Fig. 1.

Fig. 2.

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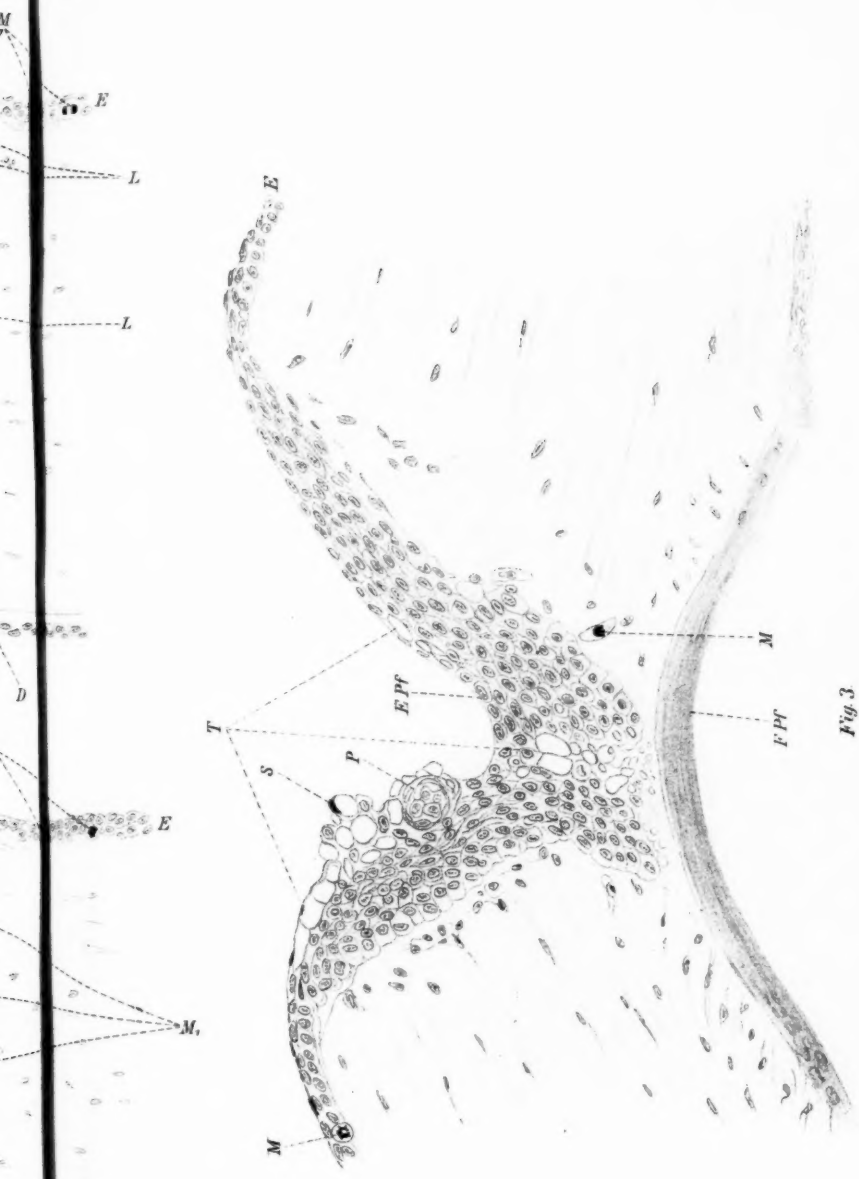

Fig. 3

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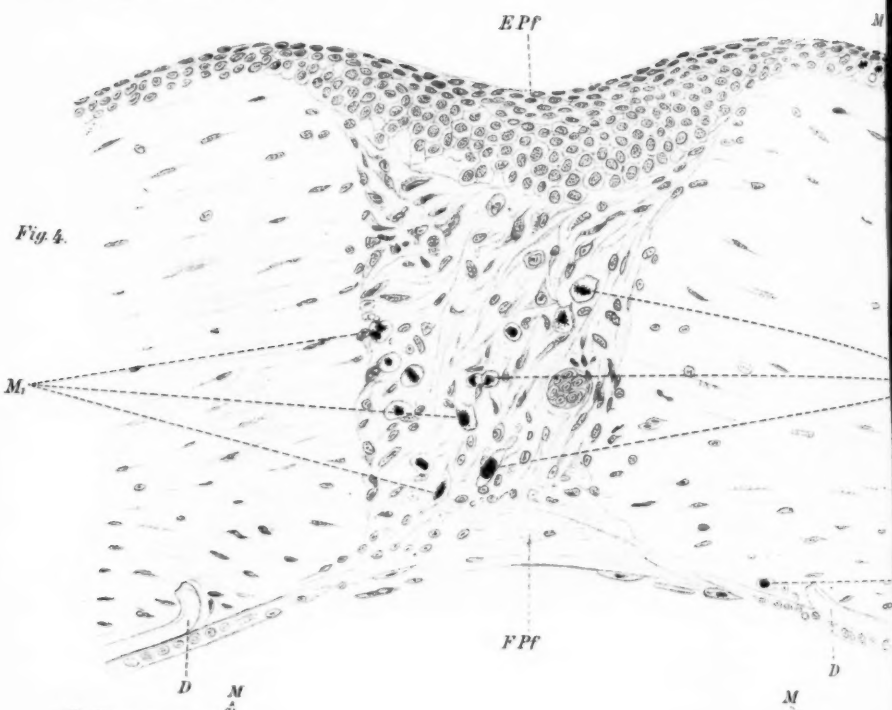
Fig. 4.



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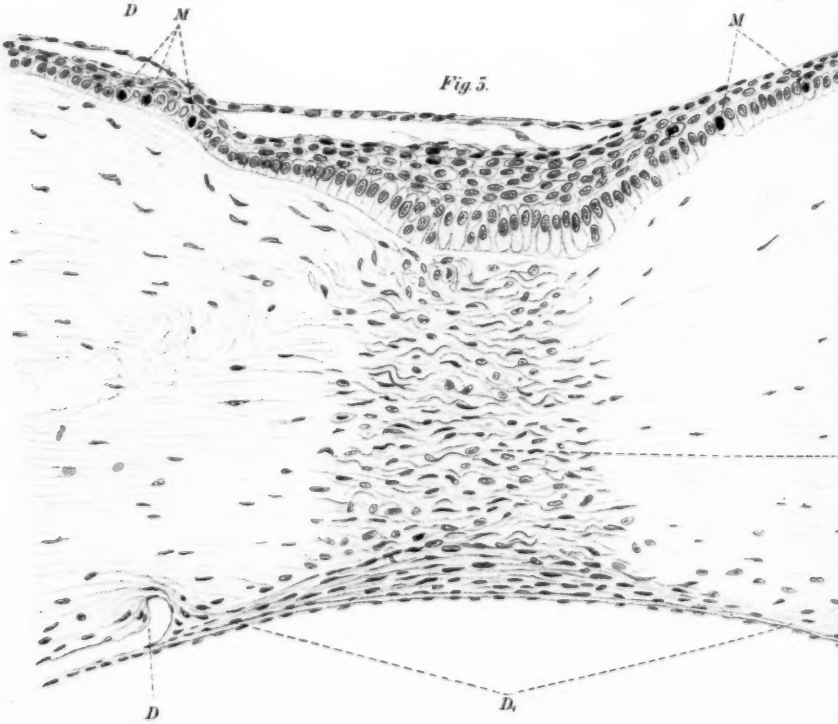

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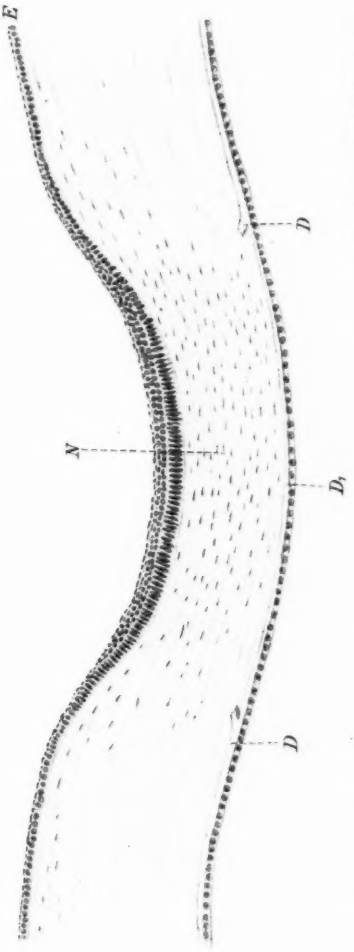

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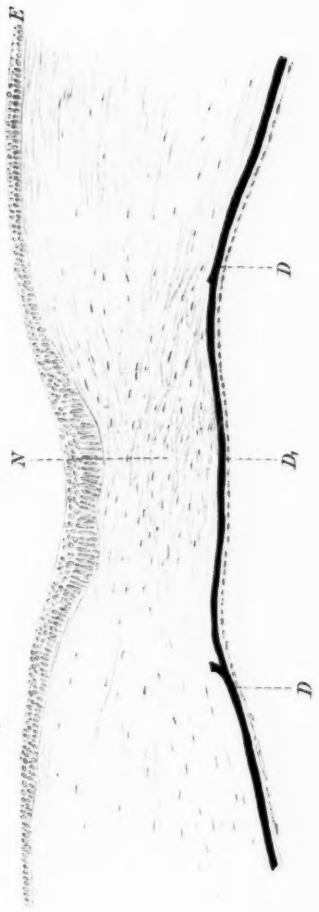

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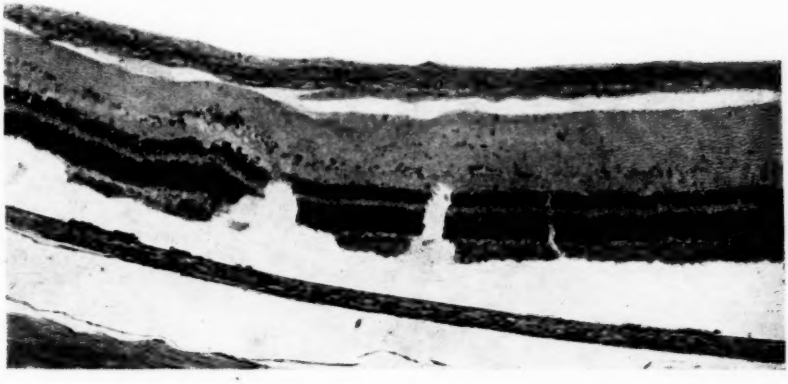

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